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PHYSICS ABSTRACTS

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Physics Abstracts

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PHYSICS ABSTRACTS

Volume 59 FEBRUARY Number 698

MATHEMATICS 51

517.5

865. SOME APPLICATIONS IN PHYSICS OF THE P FUNCTION. J.I.Masters.
J. chem. Phys., Vol. 23, No. 10, 1865-74 (Oct., 1955).

The mathematical background and typical applications are presented for a recently tabulated function known as the circular coverage function. Because of its properties, this P function should prove to be a useful aid in the solution of certain problems in applied mathematics involving surface integrations in cylindrical coordinates. A tabulation of the function in its normalized form is appended. Particular attention is paid to the application of the P function to multiple scattering problems involving circular symmetry. A.

519.2

866. AN EXPANSION PRINCIPLE FOR DISTRIBUTION FUNCTIONS WITH APPLICATION TO STUDENT'S STATISTIC. G.E.Elfving.
Ann. Acad. Sci. Fennicae AI, No. 204, 8 pp. (1955).

Let x and y_n be random variables, x having a distribution function F(x), y_n tending stochastically to zero as n increases. Let t (x, y_n) be a measurable function which approaches x as $y_n \to 0$. A method is given for expanding the distribution function $F_n(x)$ of t into an infinite series. Explicit evaluation is made in the case of Student's statistic, and the first few terms are illustrated numerically. L.S.Goddard

519.2 : 530.145

867. BOARD GAMES WHOSE PIECES MOVE IN AN APPROXIMATELY QUANTUM MECHANICAL MANNER. F.Bopp.
Z. Naturforsch., Vol. 10a, No. 9-10, 783-9 (1955). In German.

It is shown by example that in general stochastic processes satisfy equations for damped oscillations of coupled oscillators. For small damping these equations become experimentally indistinguishable from basic equations of quantum mechanics. P.T.Landsberg

519.2 : 530.145

868. QUANTUM MECHANICAL AND STOCHASTIC PROCESSES. F.Bopp.
Z. Naturforsch., Vol. 10a, No. 9-10, 789-93 (1955). In German.

Further considerations are put forward to show that it is not possible to distinguish between processes which obey quantum mechanics and stochastic processes, which "correspond" to them in a certain sense. P.T.Landsberg

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.21

869. THE NEW SCHMIDT TELESCOPE OF THE HAMBURG OBSERVATORY. O.Heckmann.
Nature (London), Vol. 176, 805-6 (Oct. 29, 1955).

A description of a telescope, planned in 1936, recently dedicated at Bergadorf, near Hamburg. The main mirror is 48 in., focal ratio f2, carried in a double-walled tube to reduce flexure. There is an automatic temperature compensation for focus by rods connecting the plate holder and mirror. A 4^0 prism is available and both this and the correcting plate are of low-expansion glass transparent to ultraviolet light. The mounting is of the fork type. The movement in right ascension is obtained by the rotation of a ground steel zone of 78 in. radius supported on oil pressure bearings. Two guiding telescopes are provided and control is by Selsyn motors. The plates cover an area of 5^0 square and, if not thicker than 1 mm, can be safely bent to the necessary radius of 94 in. Tests indicate that the performance of the telescope is limited by atmospheric conditions, not by optical quality. Apprehension is expressed as to the overwhelming output of such telescopes. E.G.Martin

523.11

870. REMARKS ON NEWTONIAN COSMOLOGY. I. O.Heckmann and E.Schücking.
Z. Astrophys., Vol. 38, No. 2, 95-109 (1955). In German.

The integration of Newtonian equations of motion for a homogeneous substratum of infinite extent, with velocity field $v_i = a_{ik}(t)x_k$, is discussed. Detailed consideration is given to two special solutions: (i) a Newtonian analogue of Gödel's (1949) solution of Einstein's field equations, (ii) a model universe in which rotation is superimposed on isotropic expansion. R.A.Newing

523.11

871. ANISOTROPIC MODELS IN NEWTONIAN COSMOLOGY. II. F.Zagar.
R.C. Accad. Naz. Lincei, Vol. 19, No. 1-2, 13-16 (July-Aug., 1955). In Italian.

Solutions considered in Pt I (Abstr. 5/1956) give expanding model universes. A new class of solutions is now considered which give oscillating universes. An isotropic model is obtained as an extreme case in which a parameter associated with the models takes on a limiting value. R.A.Newing

523.161

872. SOLID PARTICLES IN THE STARS.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 687 pp. (1954).

Communications presented at the sixth International Colloquium of Astrophysics, held at Liège, July, 1954. Abstracts of some of the papers will be published later. The titles of the remaining papers are:

Pt I. DUST IN INTERPLANETARY SPACE. Dust in interplanetary space: introductory report, M.Minnaert (15-34). The role of meteoritic dust in the earth's atmosphere, F.Link (35-47. In French). On some peculiar aspects of the zodiacal light, C.Hoffmeister (72-9). Spatial density of interplanetary particles, and distribution according to their dimensions, B.J.Levine (114-24. In French). The distribution of meteor stream intensity over the celestial sphere,

E.Öpik (147-73). On the origin of the zodiacal particles, F.L.Whipple (183-4). Nomograms for ecliptic and galactic coordinates, H.Strassl (185). Discussion (186-90).

Pt II. DUST AND ASSOCIATED MOLECULES IN STELLAR ATMOSPHERES. Dust and related phenomena in stars: introductory report, O.Struve (193-222). High-velocity stars and interstellar dust, W.Iwanowska (237-40). Comparative study of five carbon stars: RY Dra, V Aql, U Hya, U Cyg and WZ Cas in the visual and infrared regions, J.Fujita (276-79). Discussion (287-8).

Pt III. EXPERIMENTAL RESEARCHES ON GRAPHITE PARTICLES, AND ON CERTAIN MOLECULES OF ASTRONOMICAL INTEREST. Laboratory investigations of the spectra of interstellar and cometary molecules: introductory report, G.Herzberg (291-331). Laboratory investigations relating to the problem of molecular carbon and soot: introductory report, B.Rosen (332-40. In French). On the temperature equilibrium and the work function of small carbon particles in flames, K.E.Schuler (360-72). The thermodynamics of carbon molecules as determined in the mass spectrometer, W.A.Chupka and M.G.Inghram (373-7). Discussion (386-89).

Pt IV. INTERSTELLAR DUST IN THE GALAXIES. Solid particles in interstellar space: introductory report, H.C.van de Hulst (393-406). Solid particles in extra-galactic nebulae: introductory report, J.H.Oort (407-10). Diffraction of light by interstellar particles in spiral galaxies, A.Elvius (414-24). Remarks on the distribution of dust in nebulae and spiral structure, B.Lindblad (425-27). Discussion (428-9). Summary of a survey on the borders of the Southern Milky Way, L.H.Shapley and A.B.Hearn (430-36). On the presence of dust and gas in the bright diffuse nebulae, G.A.Shajn, V.T.Hase and S.B.Pickelner (441-52). On comet-like nebulae V.A.Ambartsumian (458-61). The relative concentration of interstellar hydrogen and cosmic dust, B.J.Bok (480-95). Discussion (496-7). Dye filters for nebular work, K.Wurm (530-37). On the absorption of interstellar matter, L.Divan (538-41. In French). Discussion (542, 561). A new calculation of the interstellar radiation field, H.Lambrecht (562-70). Some chemical problems of interstellar grains, B.Donn (571-77). Solid grains and the balance of interstellar H_2 molecules, F.D.Kahn (578-82). Discussion (583). Theories of interstellar polarization, T.Gold (591-4). Interstellar light polarization and magnetic fields, S.B.Pickelner (595-600). Discussion (608-12).

Pt V. THE ROLE OF DUST IN THE FORMATION AND EVOLUTION OF STARS. Dust and the origin and evolution of stars, B.Strömgren (615-27). Laws of conservation, and origin of the angular momentum of stars, E.Schatzman (628-33. In French). Role of solid particles in planetary cosmogony, O.J.Schmidt (638-49. In French). The influence of dust on the equation of state of a contracting cloud and the formation of stars, R.Ebert (666-72). Discussion (684-7).

523.164

873. THE RADIO SOURCE, SAGITTARIUS A. W.Priester.
Z. Astrophys., Vol. 38, No. 2, 73-80 (1955). In German.

Observations of the radio emission at 250 and 400 Mc/s suggest that the emission results from free-free electronic transitions in a dense H II region at a distance of about 3 k parsec, the position of the source agreeing with that of a "hole" in the emission cloud noted by Sharpless (1953). The great intensity of the observed radio emission may result from the great thickness of the underlying H II zone. After correcting the results by taking into account the probable mass of the emitting gas (3×10^5), no evidence is found for a non-thermal origin of the observed radio emission. D.R.Barber

523.164

874. TRANSMISSION OF SPATIAL FREQUENCIES IN SHORT-WAVE RECEIVER SYSTEMS. J.Arsac.
Optica Acta, Vol. 2, No. 3, 111-18 (Oct., 1955). In French.

An analysis of the methods used in radioastronomy for the observation of brightness distribution across an extended source leads to results analogous to those of classical optical systems. The distribution function can be decomposed into a number of spatial frequencies. A given aerial reseau transmits those harmonics corresponding to the separate distances between pairs of individual aerials. The properties and advantages of incomplete reseaux, in which the separations are so adjusted that the maximum number of harmonics for the given number of aerials are transmitted, are discussed. Consideration is given to the effects of finite band-width and side-lobes of the individual aerials. M.W.Ovenden

523.164.3

875. RADIO WAVES EMITTED BY THE PLANET JUPITER AND A COSMOGONICAL HYPOTHESIS. ON THE GREAT IMPORTANCE OF THE RADIO WAVES EMITTED BY THE PLANET JUPITER. Q.Majorana.
R.C. Accad. Naz. Lincei, Vol. 18, No. 6, 577-80 (June); Vol. 19, No. 1-2, 17-22 (July-Aug., 1955). In Italian.

Recent reports of radio emission from Jupiter are discussed in relation to the author's theory of the surface temperatures of planets (Abstr. 5165/1955). R.A.Newing

523.164.3

876. LOCATION ON JUPITER OF A SOURCE OF RADIO NOISE. C.A.Shain.
Nature (London), Vol. 176, 836-7 (Oct. 29, 1955).

Observations of radiation from Jupiter on 18.3 Mc/s made with a receiver with a narrow beam in declination, but a broad beam in right ascension, during the period October 1950-April 1951 are discussed. The occurrence of bursts is shown to be associated with a period of $9^h55^m13^s \pm 5^s$, which is close to the rotation period of Jupiter for System II of zenocentric longitude. An identification of the source of radiation with a visually-observed disturbance on the boundary between the south temperate zone and belt on Jupiter is suggested. M.W.Ovenden

523.164.32

877. THREE-MILLIMETER WAVE RADIATION FROM THE SUN. W.Gordy, S.J.Ditto, J.H.Wyman and R.S.Anderson.
Phys. Rev., Vol. 99, No. 6, 1905 (Sept. 15, 1955).

Solar radiation has been detected on 3.2 mm. Details of the instrumental technique are given. The decrease in signal strength caused by atmospheric haze or clouds was readily noticeable. M.W.Ovenden

523.164.42 : 523.35

878. LUNAR OCCULTATION OF A RADIO STAR AND THE DERIVATION OF AN UPPER LIMIT FOR THE DENSITY OF THE LUNAR ATMOSPHERE. B.Elsmore and G.R.Whitfield.
Nature (London), Vol. 176, 457-8 (Sept. 3, 1955).

An intensity-curve for a period of 25 minutes during the ingress phase of a lunar occultation of the radio source 2C.537 (associated with the galactic nebulosity IC443) has been obtained on 3.7 m; additional observations on 7.9 m are also available. Departures from the intensity-curve predicted for a circularly-symmetrical source can be explained on the assumption that the intensity of radio radiation from any part of the source is related to the intensity of the H-alpha emission of the nebulosity. The delay in the reappearance of a particular bright area can be estimated to be less than 4 minutes, from which an upper limit of 10^5 electrons per cm^3 for any lunar atmosphere can be derived. For a degree of ionization as great as that of the terrestrial F-layer, this electron density corresponds to a density for the lunar atmosphere of less than 10^{-12} times the surface density of the terrestrial atmosphere. M.W.Ovenden

523.164.8

879. APPLICATIONS OF RADAR TO ASTRONOMY AND METEOROLOGY (Les applications du radar à l'astronomie et à la météorologie). J.Van Bladel.
Paris: Gauthier-Villars (1955) vi + 147 pp. In French.

The following topics are discussed: fundamental principles of radar observation, detection of celestial bodies (lunar echoes, planets), detection of meteors, and statistics of sporadic and shower meteors, detection of the aurora borealis and lightning, detection of atmospheric precipitation and the determination of the coordinates of a balloon-sonde.

M.W.Ovenden

523.164.85

880. REMARKS ON THE ELECTROPHYSICAL (RADAR) DETERMINATION OF THE VELOCITIES OF METEORS. C.Hoffmeister.
Naturwissenschaften, Vol. 42, No. 16, 458 (1955). In German.

It is suggested that the radar determination of meteor velocities is subject to a systematic error due to the expansion of the cylinder of ionization which reflects the radio wave. It is pointed out that the velocities for the δ-Aquarid stream obtained by radar methods are, on the average, some 6% lower than those determined photographically. Such an error would be crucial in the detection of hyperbolic meteors.

M.W.Ovenden

523.164.85

881. DIURNAL VARIATIONS IN THE NUMBER OF SHOWER METEORS DETECTED BY THE FORWARD-SCATTERING OF RADIO WAVES. II. EXPERIMENT. P.A.Forsyth, C.O.Hines and E.L.Vogan.
Canad. J. Phys., Vol. 33, No. 10, 600-6 (Oct., 1955).

For Pt I, see Abstr. 8451(1955). The theory developed in Pt I is applied to derive the expected diurnal variations of the meteor signal rate for four showers as observed by means of a particular forward-scatter transmission path (Cedar Rapids–Ottawa). These results are then compared with the experimental signal rates. The good agreement obtained indicates that the approximations inherent in the theory are sufficiently accurate for practical purposes. The results also indicate that very few meteors, if any, are observed under conditions which do not satisfy the requirements for specular reflection. A.

523.41

882. FEASIBILITY OF A NONRELATIVISTIC EXPLANATION FOR THE ADVANCE OF THE PERIHELION OF MERCURY. E.Gerjuoy.
Amer. J. Phys., Vol. 24, No. 1, 3-6 (Jan., 1956).

Nonrelativistic explanations for the advance of Mercury's perihelion are described, and the point made that Einstein's theory is favoured over these because of his theory's intellectual appeal. Consideration is given to the possibility that the perihelion advance could be explained by hypothesizing a charge on the Sun which induces a dipole on Mercury and thereby causes a departure, from inverse square, of the total force between the Sun and Mercury. It is shown that such a hypothesis runs into serious difficulties. The results of the calculations are thought to be illustrative of the difficulties which are encountered by an attempt to account for the advance by postulating heretofore unsuspected interactions between Mercury and other bodies. A.

523.661

883. THE CONSERVATION OF FREE RADICALS AT LOW TEMPERATURE AND THE STRUCTURE OF THE NUCLEI OF COMETS. L.Haser.
C.R. Acad. Sci. (Paris), Vol. 241, No. 12, 742-3 (Sept. 19, 1955). In French.

Based on recent experiments on "imprisoned radicals" (Pimentel: G.Porter et al., 1955), an hypothesis is outlined to explain how the phenomena observed in cometary nuclei at great heliocentric distances (about 2.5 a.u.) may arise. The radicals involved, OH, NH, CN, CH and C_2, C_3, are associated with crystals of frozen H_2O, CH_4 and NH_4; and are present in the nuclei in place of an icy-conglomerate of these same molecules. D.R.Barber

523.72

884. BRIGHTENING OF THE SOLAR LIMB IN THE FAR ULTRA-VIOLET. C.M.Minnis.
Nature (London), Vol. 176, 652-3 (Oct. 1, 1955).

At the total solar eclipse of June 30, 1954 (near solar minimum) measurements of electron density in E and F1 ionospheric layers, made at Inverness and Slough (about 700 km apart), suggested that there was a definite brightening of the solar limb near the equator; a darkening near both poles, extending over arcs from 40 to 60 degrees long; and a discrete bright spot at position-angle, 255 degrees, and radial distance, 0.95 $R_\odot$. Together, these departures from the uniformly-radiating disk account for the observed E and F1 ionising radiation; and they may well be permanent features of the quiet sun. D.R.Barber

523.72 : 551.521.67

885. CORPUSCULAR STREAMS. R.C.Jennison.
Observatory, Vol. 75, 125-6 (June, 1955).

The estimates of electron density in the solar corpuscular streams postulated to account for terrestrial auroral and magnetic phenomena are close to estimates of the normal gas density in the neighbourhood of the earth's orbit. The density of the stream close to the sun cannot greatly exceed the density of the associated layers of the outer regions of the sun. It is suggested that the forward momentum of the stream is carried in the wake of a shock wave originating in the chromosphere and travelling through the outer corona to distances beyond the earth's orbit. Ionization by the electrons in the shock wave front is plausible. M.W.Ovenden

523.77

886. RESULTS OF A RECENT ATTEMPT TO RECORD THE SOLAR SPECTRUM IN THE REGION OF 900-3000 Å. A.S.Jursa, F.J.LeBlanc and Y.Tanaka.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1085-6 (Dec., 1955).

Recent u.v. solar spectra, obtained with a rocket-borne grating spectrograph (mean dispersion, 41.5 A/mm) at altitudes between 94 and 112 km reveal, in addition to numerous Fraunhofer absorption lines, the very strong Lyman Hα, and six other emission lines of differing intensities in the spectral range, 2000 A to the limit at 900 A. Some of the emissions have already been identified (Johnson et al., 1955). Lyman H β is not present, probably because of under-exposure in this region. D.R.Barber

523.77

887. THE INTENSITY AT THE BOTTOM OF THE FRAUNHOFER D LINES. J.A.Scrimger and D.M.Hunten.
Canad. J. Phys., Vol. 33, No. 12, 780-4 (Dec., 1955).

The line profiles were measured by scanning a photomultiplier and exit slit in the second order of a 21 ft grating. The large distortions resulting from finite resolution were evaluated by means of an absorbing cell containing sodium vapor with helium at a pressure of 170 mm. This produced an artificial line whose central intensity was known to be zero. By matching its profile carefully to that of the solar line the central intensities of D_1 and D_2 were found to be $(5.0 \pm 0.6)\%$ and $(4.8 \pm 0.6)\%$ in terms of the nearby continuum. A.

PHYSICS 53

53

888. INTRODUCTORY PHYSICS IN A PROGRAM OF DIRECTED STUDIES. J.K.Major.
Amer. J. Phys., Vol. 24, No. 1, 30-3 (Jan., 1956).

Orthodox courses and textbooks in elementary physics are criticized for too much material, too little interrelation to other disciplines, too much emphasis on practical applications, too little modern physics, and too little opportunity for student initiative. The selective rather than general approach is briefly reviewed, and a course described which is part of the Directed Studies in the Liberal Arts at Yale, an experiment in a prescribed curriculum for the first two years. Elementary Atomic Physics, with no prerequisites, devotes the first term to a background in classical physics centred around particle dynamics and electrodynamics, and the second term to atomic and nuclear physics. General reaction appears favourable, and screening students according to backgrounds, introducing seminars with opportunities for laboratory experiments, and integrating physics more closely with other courses are suggested improvements. A.

53.081

889. MEASUREMENTS AND CALCULATIONS IN PHYSICS. FUNDAMENTALS OF THE INTRODUCTION OF PHYSICAL QUANTITIES AND THE DEFINITION OF UNITS. (Messen und Rechnen in der Physik. Grundlagen der Grösseneinführung und Einheitenfestlegung.) U. Stille.
Braunschweig: Friedr. Vieweg and Son (1955) viii + 416 pp. In German.

A detailed systematic classification and explanation of the concepts and relations between physical quantities, units and dimensions in use in physics, together with a description of the various standards and constants and their measurement. Section 1 deals with the general theoretical background, including the recent treatment of Fleischman; sections 2–5 respectively with mechanics, heat and thermal radiation, electricity and magnetism, acoustics and light; section 6 with the numerical data and other details of the standards and constants; and section 7 presents in 35 tables a summary of the units, dimensions, definitions and numerical values of the quantities discussed in the previous sections. The recommendations and resolutions of international and other bodies regarding units and standards are quoted in the original and include those up to the end of 1954, while the approximately 1000 literature references include work up to the middle of 1954. An important reference and source book giving both the present agreed values and nomenclature and also previous developments and changes. S. Weintroub

53.084 : 621.317.729

890. AN IMPROVED PROBE ASSEMBLY FOR USE WITH AN ELECTROLYTIC TANK. M.K.Weston.
J. sci. Instrum., Vol. 32, No. 9, 367 (Sept., 1955).

The assembly uses a carriage consisting of two parts separated by, and running on, bearing balls on both sides of a transparent plotting table, and kept together by magnetic attraction. A.O.Stanesby

FUNDAMENTALS 530.1

530.12

891. SOME REMARKS ON THE THEORY OF RELATIVITY. L.Infeld.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 229-40 (1955). In German.

A general discussion of absolute and relative concepts in Newtonian mechanics and in the special and general theories of relativity, with special reference to the significance of inertial systems. The relation of the theories to dialectical materialism is also considered. R.A.Newing

530.12

892. FOUNDATIONS OF A LINEAR FIELD THEORY. H.T.Flint.
Z. Phys., Vol. 147, No. 4, 401-5 (1955).

Scherrer's expression for parallel displacement (Abstr. 9908/1954) is compared with those of Einstein (1928) and Band (1942). W.A.Hepner

530.12

893. ON THE GENERALIZED ELECTROMAGNETIC FIELD. G.Arcidiacono.
R.C. Accad. Naz. Lincei, Vol. 18, No. 6, 631-6 (June, 1955). In Italian.

The energy tensor for the new 10-component field (Abstr. 42/1956) is set up, and equations are established for the generalized potentials. It is shown that the generalized Maxwell equations may be deduced from a variation principle. R.A.Newing

530.12

894. ON THE STATIC CHARACTER OF A STATIONARY MODEL UNIVERSE IN THE JORDAN–THIRY UNIFIED THEORY. Y.Thiry.
C.R. Acad. Sci. (Paris), Vol. 241, No. 11, 691-2 (Sept. 12, 1955). In French.

In the general theory of relativity, a stationary asymptotically Euclidean universe is necessarily static. The generalization of this result in the author's 5-dimensional theory is discussed. R.A.Newing

530.12

895. ON EQUATIONS OF MOTION IN GENERAL RELATIVITY. G.E.Tauber.
Canad. J. Phys., Vol. 33, No. 12, 824-7 (Dec., 1955).

It has been shown that both the equations of motion of a charged particle in a gravitational field and the field equations can be obtained from one variational principle by suitably generalizing Dirac's classical theory of electrons. A.

530.12

896. RELATIVISTIC THEORY OF DISCRETE MOMENTUM SPACE AND DISCRETE SPACE-TIME. E.L.Hill.
Phys. Rev., Vol. 100, No. 6, 1780-3 (Dec. 15, 1955).

An examination is made of the result of restricting translations and Lorentz transformations in space-time to those with rational coefficients. This removes the major defect of Schild's model of discrete space-time by elimination of the lower bound on the relative velocities of reference systems. The theory is formulated in two stages. In the first the energy and momentum components of a particle are restricted to a countable set satisfying the relativistic energy-momentum space in which wave functions are almost periodic functions. In the second stage the space-time variables are restricted to rational values. This leads to the theory of discrete space-time. A.

530.12

897. SCALAR FIELD THEORY AS A THEORY OF GRAVITATION. I. O.Bergmann.
Amer. J. Phys., Vol. 24, No. 1, 38-42 (Jan., 1956).

A Lorentz-invariant theory of gravitation is examined in which the field variable is a scalar in the sense of the four-dimensional tensor calculus. The Kepler-motion has the same form as in Nordström's theory and differs accordingly from

the vector theory. The perihelion motion is of the same absolute value as in the vector theory, and hence much too small in comparison with the experimental value for the planet Mercury, and moreover of the wrong sign. The influence of radiation damping is to be discussed in a second paper. A.

530.12 : 523.11

898. JORDAN'S COSMOLOGY WITH NEW FIELD EQUATIONS. K.Just.
Z. Phys., Vol. 141, No. 5, 592-603 (1955). In German.

Difficulties arising in the linear expanding model (Abstr. 8477/1955) can be avoided by using field equations for which $c = 0$, $s > 0$, $s \simeq 1$. In the case of negligible radiation pressure, the new field equations give a universe in which the gravitational constant κ decreases with age, tending asymptotically to a constant value. The new model involves a "characteristic time" τ which is a constant of integration whose value is estimated to be from 10^{-2} to 10^{-1} times the present age t_0 of the universe. The generation of new stars and variations in κ are appreciable only at epochs $t < \tau \ll t_0$. R.A.Newing

530.145

899. COMPLEMENTARITY AND LOGIC.
C.F.v.Weizsäcker.
Naturwissenschaften, Vol. 42, No. 19, 521-9 (1955). In German.

Interpretations of complementarity by different authors are discussed. Bohr's original formulation is considered. The view that the quantum physicist uses a different logic from the classical is put forward and an introduction to such a logic is given. See also abstract following. G.E.Brown

530.145

900. COMPLEMENTARITY AND LOGIC.
C.F.v.Weizsäcker.
Naturwissenschaften, Vol. 42, No. 20, 545-55 (1955). In German.

See preceding abstract. The logic of the quantum physicist is discussed. The theory of Birkhoff and von Neumann is considered. G.E.Brown

530.145

901. QUANTUM FIELD THEORY IN TERMS OF VACUUM EXPECTATION VALUES. A.S.Wightman.
Phys. Rev., Vol. 101, No. 2, 860-6 (Jan. 15, 1956).

Vacuum expectation values of products of neutral scalar field operators are discussed. The properties of these distributions arising from Lorentz invariance, the absence of negative energy states and the positive definiteness of the scalar product are determined. The vacuum expectation values are shown to be boundary values of analytic functions. Local commutativity of the field is shown to be equivalent to a symmetry property of the analytic functions. The problem of determining a theory of a neutral scalar field given its vacuum expectation values is posed and solved. A.

530.145

902. PROBLEMS OF THE QUANTUM THEORY OF THE FIELD. N.N.Bogolyubov and D.V.Shirkov.
Uspekhi fiz. Nauk, Vol. 55, No. 2, 149-214 (1955). In Russian.

This is to be the first of a set of articles in which the basic assumptions of field theory are examined critically. Here are discussed: the theory of free wave fields, operator expressions and singular functions, theory of interacting fields, Lagrangian of interaction and the S-matrix, expansion of T-products based on the theory of Vick and its application to Feynman rules, use of Feynman rules. 21 references.
C.R.S.Manders

530.145

903. DECOMPOSITION INTO FUNCTIONS OF DYNAMICAL VARIABLES OF THE ENERGY–MOMENTUM TENSOR OF RELATIVISTIC FLUIDS ENDOWED WITH INTERNAL ANGULAR MOMENTUM. F.Halbwachs, G.Lochak and J.P.Vigier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 11, 692-5 (Sept. 12, 1955). In French.

The Møller–Weyssenhoff theory of fluids with intrinsic spin is extended to the case of a fluid subject to internal stress. R.A.Newing

530.145

904. THE LORENTZ-INVARIANT TWO-PARTICLE EQUATION AND REPRESENTATIONS OF THE LORENTZ GROUP. G.Grawert.
Z. Phys., Vol. 143, No. 4, 435-50 (1955). In German.

Without assumptions about the interaction, the condition that the integral equation for the wave function of two particles in quantized field theories must be invariant under translations and Lorentz transformations leads to qualitative results about the possible solutions. The interpretation of the result of the reduction of the Hilbert space of the wave functions is that bound states as well as scattering states can be described by the homogeneous Bethe–Salpeter equation. W.A.Hepner

530.145

905. INADMISSIBLE AUXILIARY CONDITIONS IN QUANTIZED LINEAR SYSTEMS. J.K.Percus.
Phys. Rev., Vol. 100, No. 4, 1208-13 (Nov. 15, 1955).

Methods of applying supplementary linear conditions to quantized linear systems are reviewed; it is seen that such a procedure is self-consistent for Fermi–Dirac systems in general, and for Einstein–Bose systems possessing positive definite constants of the motion. Possible modifications are discussed for those cases in which the operator conditions to be added appear intrinsically inconsistent with the commutation relations. Alterations of the commutation relations which maintain the invariance properties of the system are found to be generally inapplicable. Increasing the number of side conditions achieves the desired objective, but at the expense of reducing drastically the class of constants of motion. Finally the introduction of a restricted set of field variables is explored. It is shown that the new variables, in terms of which all pertinent field quantities may be expressed, permit a consistent formulation to be realized; the case of a massless spin s boson field is treated in this manner. A.

530.145

906. VACUUM POLARIZATION IN A STRONG COULOMB FIELD. E.H.Wichmann and N.M.Kroll.
Phys. Rev., Vol. 101, No. 2, 843-59 (Jan. 15, 1956).

A study is carried out of the vacuum polarization in a strong Coulomb field. Radiative corrections are neglected. A perturbation calculation is avoided by making use of the explicit solutions of the Dirac equation in a Coulomb field. The Laplace transform of the polarization charge density times r^2 is found and used as a basis for further study. It is proved to be an analytic function of the strength of the inducing charge. It is verified that the first-order term in a power series expansion in the strength of the inducing charge just corresponds to the Uehling potential. The third-order term is studied in some detail. The leading term in the polarization potential close to the inducing charge and the space integral of the induced potential divided by r are found to all orders in the strength of the inducing charge. Ambiguities are handled by a method corresponding to regularization. Some experimental applications are considered. The corrections to the Uehling term in these cases are found to be small. A.

530.145

907. SPECTRUM AND NONRELATIVISTIC LIMIT OF A BETHE–SALPETER EQUATION. F.L.Scarf.
Phys. Rev., Vol. 100, No. 3, 912-24 (Nov. 1, 1955).

The eigenvalue spectrum of the relativistic two-body equation introduced by Wick is investigated in detail for

arbitrary binding energy. It is verified that for any nonzero binding energy there is a complete discrete spectrum of allowed coupling constants and that this spectrum is labeled by the four quantum numbers n, l, m and κ. In the limit of zero binding energy, it is shown that all eigenvalues tend to zero. The set of coupling constants with $\kappa = 0$ correspond best to the Balmer formula. The wave-functions are also investigated with respect to certain proposed boundary conditions and are compared with the nonrelativistic hydrogen atom wave-functions. Again it is found that all states with $\kappa = 0$ correspond best to the nonrelativistic states, but that the "spurious" states with $\kappa > 0$ are not unacceptable. Possible generalizations of these results are discussed. A.

530.145

908. RADIATIVE CORRECTIONS TO DECAY PROCESSES. R.E.Behrends, R.J.Finkelstein and A.Sirlin.
Phys. Rev., Vol. 101, No. 2, 866-73 (Jan. 15, 1956).

Radiative corrections associated with the electromagnetic field have been determined for the decay of a fermion of arbitrary mass into a lighter one with the emission of a single boson or of two other fermions; no special assumptions have been made about the nature of the interaction responsible for the instability. The particular example of the muon-electron decay has been worked through in detail. Sufficiently accurate experimental determination of the muon spectrum would permit the observation of a Lamb term without vacuum polarization. Modified formulas for the Michel parameter p are given. A.

530.145

909. CLASSICAL DERIVATION AND INTERPRETATION OF HEBER'S NUCLEON MODEL. W.R.Theis.
Naturwissenschaften, Vol. 42, No. 22, 600-1 (1955). In German.

It is shown that Heber's model of the nucleon (Abstr. 8497/1955) can be obtained from a classical treatment of the scalar neutral meson field, the finite extension and self-energy being due to the attractive potential between like particles in this particular case. The divergencies of the quantized theory are not entirely removed with this model. W.A.Hepner

530.145

910. RELATIVISTIC HYDRODYNAMICS EQUIVALENT TO THE DIRAC EQUATION. T.Takabayasi.
Progr. theor. Phys., Vol. 13, No. 2, 222-4 (Feb., 1955).

Current and spin density are defined in terms of the vector and pseudo-vector bilinear covariants, and Eulerian equations of flow and equations of motion for spin distributions are set up. R.A.Newing

530.145

911. MODEL OF THE CAUSAL THEORY OF RELATIVISTIC MICRO-OBJECTS OF ARBITRARY SPIN IN TERMS OF A RELATIVISTIC FLUID ENDOWED WITH INTERNAL ANGULAR MOMENTUM. F.Halbwachs, G.Lochak and J.P.Vigier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 12, 744-6 (Sept. 19, 1955). In French.

A hydrodynamic model valid for particles with spin is obtained in terms of a Møller-Weyssenhoff fluid subject to internal stress. R.A.Newing

530.145

912. ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON. K.Haller and M.H.Friedman
Phys. Rev., Vol. 100, No. 5, 1501-2 (Dec. 1, 1955).

The ground-state solution of the physical nucleon problem in the Tomonaga approximation is used to compute the anomalous magnetic moment of nucleons. When computed on the basis of parameters that make the phase-shift calculations in the Tomonaga approximation consistent with meson-nucleon scattering data, the values obtained are +1.48 for the proton and −1.48 for the neutron. A.

530.145 :537.12

913. THE SELF-INTERACTION OF THE ELECTRON. R.Haag.
Z. Naturforsch., Vol. 10a, No. 9-10, 752-61 (1955). In German.

A formulation of Dirac's theory of the classical electron is given in which the paradox of self-acceleration is excluded from the beginning. It is shown that Eliezer's generalization of the Dirac theory is not acceptable. The theory has a nonlocal character. G.E.Brown

530.145

914. SCALAR FIELD OF A NUCLEON AT REST IN NONLINEAR THEORY. N.V.Mitskevich.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 354-61 (1955). In Russian.

Behaviour of spherically symmetrical solutions of the equation $\Box\phi - (k_0^2 + \lambda\phi^2)\phi = 0$ is investigated for $\lambda > 0$ and $\lambda < 0$. The energy of the field is required to be finite. General properties of the (classical) solution are discussed, such as behaviour at the origin and at infinity. An approximate solution is proposed. Self-energy of the nucleon is evaluated. G.E.Brown

530.145

915. ON THE PROBLEM OF THE ASYMPTOTIC GREEN'S FUNCTION IN MESON THEORY WITH WEAK PSEUDOSCALAR COUPLING. E.S.Fradkin.
Zh. eksper. teor. Fiz., Vol. 29, No. 3(9), 377-9 (1955). In Russian.

Asymptotic, unrenormalized equations are given; the Green's function found from these is the same as the renormalized expression found by Abrikosov et al. (1954). G.E.Brown

530.145

916. ON THE THEORY OF STRONG COUPLING FOR MESON FIELDS. I. B.T.Geĭlikman.
Zh. éksper. teor. Fiz., Vol. 29, No. 4 (10), 417-29 (1955). In Russian.

Scalar and pseudoscalar meson fields in strong coupling and in the no-recoil approximation are considered. The nucleons have a structure given by a four-dimensional form-factor. In analogy to the Born–Oppenheimer molecular theory, equations are solved with neglect of the kinetic energy in zero order to give non-operator approximations to the fields. The kinetic energy and corrections to the fields are then considered as perturbations. In this way a perturbation expansion in inverse powers of the coupling constant is constructed. G.E.Brown

530.145

917. ON THE THEORY OF STRONG COUPLING FOR MESON FIELDS. II. B.T.Geĭlikman.
Zh. éksper. teor. Fiz., Vol. 29, No. 4 (10), 430-8 (1955). In Russian.

With the perturbation theory of Pt I, the strength of interaction of two nucleons and the scattering of mesons by nucleons are investigated. The theory yields bound states of mesons. G.E.Brown

530.145

918. ON THE THEORY OF STRONG COUPLING FOR MESON FIELDS. III. B.T.Geĭlikman.
Zh. éksper. teor. Fiz., Vol. 29, No. 5 (11), 572-84 (1955). In Russian.

The treatment of Pts I and II is generalized to take account of nucleon motion in a strong coupling approximation. After going over to a completely relativistic description and a point nucleon–meson interaction (with attendant divergence difficulties) the polarization of the nucleon vacuum is treated. G.E.Brown

530.145

919. ON THE PROBLEM OF THE INTERACTION OF NUCLEONS THROUGH THE PSEUDOVECTOR MESON FIELD. A.A.Rukhadze.
Zh. eksper. teor. Fiz., Vol. 29, No. 5 (11), 709-11 (1955). In Russian.

Renormalization in the lowest order of the Tamm–Dancoff approximation is discussed. G.E.Brown

530.145

920. ON THE ELECTRON–NEUTRON INTERACTION. M.Yamada.
Progr. theor. Phys., Vol. 13, No. 1, 124-6 (Jan., 1955).

The contributions to the equivalent square-well potential are estimated, which come from the presence of single virtual pseudoscalar mesons. The Feynman graphs for the interaction of a virtual nucleon (proton) and of a virtual meson, with the radiation field are considered as a first approximation. G.Field

530.145

921. TWO-NUCLEON POTENTIAL FROM THE CUT-OFF YUKAWA THEORY. S.Gartenhaus.
Phys. Rev., Vol. 100, No. 3, 900-5 (Nov. 1, 1955).

Using the Yukawa theory with cutoff, the two-nucleon interaction is calculated up to fourth order in the coupling constant. The resulting potential at large distances (greater than about 10^{-13} cm) is similar to the well-known potential with no cutoff. At small distances, however, the tensor potential approaches zero, and the central potential is strongly repulsive. The details are essentially determined by two parameters, the coupling constant and cutoff. The Schrödinger equation for the two-nucleon problem at low energies is solved numerically, and values are obtained for the binding energy, the quadrupole moment, and the four n–p scattering parameters. It is found that the triplet experimental values are reproduced quite well, and the singlet parameters reasonably well by the same coupling constant and cutoff required to explain pion–nucleon scattering and photoproduction. A.

530.145

922. CONTRIBUTION TO THE THEORY OF THE MULTIPLE SCATTERING OF PARTICLES. R.Mertens.
Simon Stevin, Suppl., Vol. 30, 11 pp. (1954). In Dutch. Summary (6 pp.) in English.

The multiple scattering of particles is treated by the approximate method consisting in the expansion of the angular distribution function in a series of Legendre polynomials. The difficulties to which the existing theories lead are investigated. A new method due to J.Yvon is developed in detail for the solution of Milne's problem for isotropic neutrons and is improved by an iteration process. It has been further extended to the more complicated problem of the multiple scattering of particles, whose single scattering law is no longer isotropic, in a medium of finite thickness. Throughout the work the Boltzmann equation is chosen as a starting-point. It is assumed, that the collisions between particles and atoms are elastic and that the velocity of the particles remains constant. The principal aim is to establish general approximate methods, which can be applied with good result to problems that cannot be solved exactly (e.g. the multiple scattering in media of finite thickness). G.E.Brown

530.145

923. MULTIPLE ISOTROPIC SCATTERING. P.I.Richards.
Phys. Rev., Vol. 100, No. 2, 517-22 (Oct. 15, 1955).

A formalism is derived for approximately solving problems in the transport of radiation or particles by isotropic scattering with absorption. Although the present theory is very similar to diffusion theory, comparison with rigorous solutions where available shows that the results are more accurate than those of diffusion theory especially in highly absorbing media and in regions close to sources. Moreover certain ambiguities and difficulties in extending diffusion theory are eliminated. The derivation proceeds directly from rigorous transport equations and is based on a series expansion for integrals of the Helmholtz type. A.

530.145

924. STATE–VECTOR NORMALIZATION IN FORMAL SCATTERING THEORY. B.S.DeWitt.
Phys. Rev., Vol. 100, No. 3, 905-11 (Nov. 1, 1955).

The familiar problem of state–vector normalization and, in field theories, the related problem of charge renormalization are shown to arise in a natural manner in the formal scattering theory introduced by Lippmann and Schwinger. The mathematical arguments necessary for dealing with these problems are developed entirely within the framework of the formal theory and lead to the customary rules for the construction of the renormalized S-matrix and reactance operator, provided mass renormalization is simultaneously carried out and the one-to-one correspondence between perturbed and unperturbed eigenstates is set up in a "natural" fashion. A.

530.145

925. DISPERSION RELATIONS FOR PION-NUCLEON SCATTERING. I. THE SPIN-FLIP AMPLITUDE. R.Oehme.
Phys. Rev., Vol. 100, No. 5, 1503-12 (Dec. 1, 1955).

Dispersion relations are derived for the derivative with respect to $\sin\theta$, taken at zero angle, of the spin-flip amplitude for pion-nucleon scattering. The derivation of these relations is based on general field-theoretical concepts. It is shown that the condition of microscopic causality is sufficient and essentially also necessary for the existence of these equations. The special form of the dispersion relations depends on the assumptions about the high-frequency behaviour of the spin-flip amplitude. The exact dispersion formulae, which are derived under the more stringent boundedness condition for the amplitude, can be reduced to the spin-flip part of Low's equations for P-wave scattering. This reduction involves approximations which correspond to those underlying the direct derivation of Low's equations. Under certain conditions the dispersion relations may hold approximately at low energies even if the causality condition is not valid in small but finite regions. This possibility is discussed briefly. A.

530.145

926. OPTICAL MODEL POTENTIAL FOR PION–NUCLEUS SCATTERING. R.M.Frank, J.L.Gammel and K.M.Watson.
Phys. Rev., Vol. 101, No. 2, 891-901 (Jan. 15, 1956).

The assumption that two-body forces are not appreciably modified within nuclei offers the possibility of calculating the optical-model potential from two-body scattering phenomena. For instance, the dispersion relations recently proposed by Goldberger permit one to make a calculation of the pion-nucleus well depth directly from observed pion-nucleon scattering cross-sections. The results predict a rather striking variation with energy for this potential and appear to be in fair agreement with the available experimental data. The physical basis for the potential is investigated. Numerical calculations using meson theory (in the form proposed by Chew) are in disagreement with the results from the dispersion relations (as well as the experimental values). This involves solving an equation closely related to that used by Brueckner et al. in their study of nuclear saturation. The relations of the potential to various nuclear properties are discussed — for instance, it is shown in detail that the resolution of the nuclear radius is limited to the range of the two-body interaction. A.

530.145

927. QUANTUM MECHANICS AS DIFFRACTION PHENOMENON OF GUIDING WAVES. I. THE PROPERTIES OF A SPIN-FREE PARTICLE, DEFINED BY FOUR PRINCIPLES.

R.Hosemann and S.N.Bagchi.
Z. Phys., Vol. 142, No. 3, 334-46 (1955). In German.

A generalized wave equation is set up which degenerates into the optical wave equation, the equations of Schrödinger and Yukawa and a relativistic Hamilton–Jacobi equation in various special cases. The derivation of the general equation is based on (1) Lorentz covariance, which is ensured by using space-time Faltung operations previously introduced by the authors (Abstr. 1007, 8019/1954); (2) a generalized particle mechanics in which the generalized momentum of a particle in an electromagnetic field is defined as in special relativity, except that the relativistic mass is multiplied by the factor $\mu = \sqrt{\{1 - (\hbar/m_0c)^2 (\Box a/a)\}}$, where a is the amplitude of the guiding wave; (3) a pilot-wave theory which reduces to that due to de Broglie in the case $\mu = 1$; (4) an extension of Huygens' principle. R.A.Newing

530.145

928. QUANTUM MECHANICS AS DIFFRACTION PHENOMENON OF GUIDING WAVES. II. THE PRINCIPLES OF CLASSICAL MECHANICS AND QUANTUM MECHANICS AS DEGENERATE CASES. R.Hosemann and S.N.Bagchi.
Z. Phys., Vol. 142, No. 3, 347-62 (1955). In German.

The particle aspect of the new theory which involves a "diffraction force" $-m_0c^2 \sqrt{1 - (v/c)^2}\ \mathrm{grad}\,\mu$, is expressed in Lagrange and in Hamiltonian form and reduces to classical theory when $\mu = 1$. The dynamical trajectory of a particle is found to depend on both the amplitude and phase of the guiding wave. The trajectories are considered for an ensemble of spin-free non-interacting particles whose guiding waves are identical apart from a phase-shift factor, and a generalized uncertainty relation is established which reduces to that due to Heisenberg when $|\ \mu - 1\ | \ll 1$. R.A.Newing

530.145

929. A DELINEARIZATION OF QUANTUM MECHANICS. G.Knapecz.
Z. Phys., Vol. 141, No. 5, 525-39 (1955). In German.

It is shown that: 1. ψ cannot be delinearized and the interpretation of the usual theory kept; 2. the non-linear theory must be a many-body theory. The formulation of operators is widened to give new, more general, operators. These operators are made to obey the Heisenberg commutation relations and as a result space-exchange operators are obtained, which shows that these operators are really more general than those in the usual quantum mechanics.
G.E.Brown

530.145

930. A "FREE HYPOTHETICAL WORLD" OF ELEMENTARY PARTICLES. G.Knapecz.
Z. Phys., Vol. 142, No. 4, 433-46 (1955). In German.

The matrix representation of dynamical variables, developed in the preceding abstract, is used to investigate the motion of free particles, with or without mutual interactions. For a given number, n, of fermions, with or without internal degrees of freedom, the exchange energy is found to be proportional to n(n−1) and (−n) respectively. The energy-momentum eigenvalues are not necessarily equal to the corresponding de Broglie expressions. For the case of constraints, a mass spectrum is obtained. G.Field

530.145

931. ON SCALAR PRODUCTS OF WAVE-FUNCTIONS AND ON INVERSE FOURIER INTEGRALS IN RELATIVISTIC WAVE MECHANICS. R.Potier.
J. Phys. Radium, Vol. 16, No. 8-9, 688-92 (Aug.-Sept., 1955). In French.

Costa de Beauregard's covariant formulation is adapted to the author's general theory of particles with spin and multiple mass. R.A.Newing

530.145

932. RELATIVISTIC COVARIANCE IN QUANTUM MECHANICS. O.Costa de Beauregard.
J. Phys. Radium, Vol. 16, No. 10, 770-80 (Oct., 1955). In French.

An improved formulation of the author's recent theory. See Abstr. 3461/1955. R.A.Newing

530.145

933. REDISTRIBUTION OF CLASSICAL AND QUANTUM DENSITIES. G.Breit and P.B.Daitch.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 9, 653-60 (Sept., 1955).

It is shown that, if particles impinge from right to left on a completely reflecting one-dimensional potential barrier, the integral of the quantum-mechanical density from the barrier interior to one of the nodes of the wave function on the right of the barrier is equal to the integral of the classical particle density from the classical turning point to the same node of the wave function, provided that the JWKB approximation applies at the node. The theorem is extended to radial wave functions in three dimensions. G.E.Brown

530.145

934. INTERACTION OF AN ELECTRON WITH A PHYSICAL DIPOLE. G.S.Handler.
J. chem. Phys., Vol. 23, No. 10, 1977-8 (Oct., 1955).

The quantum-mechanical solution is obtained as a special case of the general two-centre solutions presented by Baber and Hassé. G.E.Brown

530.145

935. HAMILTONIAN FORM OF INTEGRAL SPIN WAVE EQUATIONS. K.M.Case.
Phys. Rev., Vol. 100, No. 5, 1513-14 (Dec. 1, 1955).

The Hamiltonian forms of the spin-zero and spin-one wave equations are obtained simultaneously by starting from the Duffin–Kemmer form of the equations using only algebraic properties of the beta matrices. From the mode of derivation, the Hamiltonian forms for all integral-spin equations of the Dirac–Fierz–Pauli type follow immediately. A.

530.145 : 541.124

936. NOTE ON THE USE OF NON-ORTHOGONAL WAVE FUNCTIONS IN PERTURBATION CALCULATIONS. P.A.M.Dirac.
Canad. J. Phys., Vol. 33, No. 12, 709-12 (Dec., 1955).

A method of first approximation is proposed for handling collision problems involving a chemical or ionic change, so that the interaction energy function is different at the beginning and end of the collision. A.

530.162

937. ON AN APPROXIMATE VARIATIONAL PRINCIPLE IN QUANTUM STATISTICS. F.Kaschluhn.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 304-5 (1955). In German.

It is shown that the relations for the energy, entropy and free energy implied by the quantum statistical treatment of interacting particles of Abstr. 10823 (1954) are consistent with the laws of thermodynamics only if a certain additional condition is postulated. W.J.Swiatecki

530.162

938. ON THE QUANTUM-MECHANICAL TREATMENT OF MANY-BODY PROBLEMS. W.Macke.
Ann. Phys. (Leipzig), Vol. 17, No. 1, 1-9 (1955). In German.

The Thomas–Fermi equation is derived as zero-order approximation to a quantum-mechanical equation describing the system. Complete sets of eigenfunctions are used, so that it is easy to derive consistently the refinements of the statistical equation of Weizsäcker and Gombas. G.E.Brown

530.162

939. TOWARDS A BASIS OF THE THOMAS-FERMI STATISTICAL THEORY. W.R.Theis.
Z.Phys., Vol. 142, No. 5, 503-10 (1955). In German.

The exact solutions for a system of fermions in an external potential is given formally in phase space and the approximations which must be made in order to obtain the Thomas–Fermi theory are discussed. Both the exact and approximate solutions are obtained for the linear harmonic oscillator. G.E.Brown

530.162

940. PERTURBATION THEORY IN STATISTICAL MECHANICS. S.Nakajima.
Advances in Phys., Vol. 4, 363-80 (Oct., 1955).

A discussion of various methods of obtaining the perturbation expansion of the free energy when the Hamiltonian is given as the sum of an unperturbed part and a small perturbation term. The connection with quantum mechanical perturbation theory is demonstrated, and the formalism is illustrated by applying it to the electron–phonon interaction in normal metals and to the diamagnetism of a gas of charged particles. The problem of diamagnetism, including the Meissner effect, is treated also by Schafroth's method (Abstr. 3599/1952) and by the Hartree method. E.H.Sondheimer

530.162

941. QUANTUM THEORY OF FLUCTUATIONS. H.Ekstein and N.Rostoker.
Phys. Rev., Vol. 100, No. 4, 1023-9 (Nov. 15, 1955).

An operator is constructed for the spectral density of a fluctuating dynamical variable. The formulation is based on an analysis of method of measurement. An essential feature of the operator is the replacement of classical dynamical variables by time-dependent Heisenberg operators. The expectation value of the spectral density includes fluctuations of statistical origin, as well as fluctuations of quantum mechanical origin. It can be computed for any physical system when the initial state has been specified. Two applications are given: Nyquist's law is rigorously deduced for a physical system that is similar to the one discussed by Callen and Welton, and the shot effect is calculated for free uncorrelated electrons. A quantum correction is obtained whose origin lies in the wave-like character of the electron. A.

530.162

942. STATISTICAL MECHANICS OF ISOTOPIC SYSTEMS WITH SMALL QUANTUM CORRECTIONS. I. GENERAL CONSIDERATIONS AND THE RULE OF THE GEOMETRIC MEAN. J.Bigeleisen.
J. chem. Phys., Vol. 23, No. 12, 2264-7 (Dec., 1955).

It is shown that the differences in the thermodynamic properties of isotopic molecules subject to small quantum effects ($u^2/24$ law) depend on the difference in the reciprocal masses of the atoms in the molecule and are, therefore, independent of all masses except of those atoms isotopically substituted. This theorem provides a rigorous proof of the rule of the geometric mean for gaseous molecules. It is shown that the partition function ratio for a pair of double-labelled molecules, e.g., $N^{15}D_3/N^{15}H_3$ is equal to the ratio for the single-labelled pair $N^{14}D_3/N^{14}H_3$. The application of the $u^2/24$ law to isotopic isomer equilibria is pointed out. A.

MECHANICAL MEASUREMENTS 531.7

531.717

943. A METHOD OF DETERMINING PARTICLE SIZE OF POWDERS. M.L.Lakhanpal, V.D.Anand and B.R.Puri.
Nature (London), Vol. 176, 692 (Oct. 8, 1955).

Mills' apparatus (Abstr. 1442/1948) is not applicable to very fine particles and an alternative method based on permeability principles is described. The apparatus is illustrated and details are given together with an expression for the calculation of the mean particle radius. The method is stated to have been tested successfully on several powders of particles of diameters 0.015 to 0.0005 mm, with water and benzene as experimental liquids. S.Weintroub

531.75

944. APPARATUS FOR THE MEASUREMENT OF EXTREMELY SMALL WEIGHT, VOLUME, AND DENSITY CHANGES. W.K.Haller and G.L.Calcamuggio.
Rev. sci. Instrum., Vol. 26, No. 11, 1064-8 (Nov.,1955).

A pressure-controlled hydraulic balance for the measurement of extremely small weight, volume, and density changes has been developed. The movement of a calibrated pressure-sensitive glass float, carrying the sample, is observed while the pressure on the float is adjusted until equilibrium of the forces is reached and movement ceases. Changes in weight or volume of the sample or in the density of the liquid result in forces compensated for by a corresponding pressure adjustment, from which the magnitude of the changes can be calculated. Applied to the study of a rate process, it has been possible to measure continuously the weight loss of silicate glasses due to corrosion in distilled water with an accuracy of 0.0003% of 3 gram total sample weight. A.

531.752

945. A MICROGRAM BALANCE WITH JEWEL BEARING. E.Hess and W.Thomas.
Z. angew. Phys., Vol. 7, No. 12, 559-62 (1955). In German.

Describes a beam balance, maximum load 500 milligrams, sensitivity 1111 mm/mg unloaded and 909 mm/mg at maximum load with corresponding periods of oscillation of 15 and 14 sec. S.Weintroub

531.752 : 538.082

946. TORSION BALANCE FOR A SINGLE MICROSCOPIC MAGNETIC PARTICLE. S.P.Yu and A.H.Morrish.
Rev. sci. Instrum., Vol. 27, No. 1, 9-11 (Jan., 1956).

The construction and principle of operation of a new type of quartz fibre torsion balance are described. The quartz suspension fibre used can be as small as 0.5 micron diameter. This enables magnetic measurements to be made on an individual microscopic magnetic particle of about 1-micron diameter. A.

531.77

947. TACHOMETER FOR 200 TO 20 000 R.P.M. HAVING AN ACCURACY OF ±1 R.P.M. OVER THE WHOLE RANGE. V.Kroupa.
Slaboproudý Obzor, Vol. 16, No. 8, 416-22 (1955). In Czech.

The instrument is based on a decimal digital counter and comprises a gating circuit, a frequency divider and a thermostatically controlled crystal oscillator operating at 100 kc/s. The oscillator frequency is divided by means of a 5-stage multivibrator divider, thus providing accurate 1 sec timing intervals. A measured frequency is applied to the counter for a duration of 1 sec by means of the gating circuit. The recorded count can be read during 0.9 sec, after which the counter re-sets automatically and is ready to accept another series of pulses. The counter consists of 5 decades and has a maximum speed of 200 kc/s. Application of the instrument to the measurement of angular velocities requires a converting device such as a capacitive or photoelectric pick-up, or a synchronous generator. R.S.Sidorowicz

MECHANICS OF FLUIDS 532

532.13 : 533.16

948. INTRINSIC VISCOSITY AND KINEMATIC VISCOSITY.

C. Tanford.
J. phys. Chem., Vol. 59, No. 8, 798-9 (Aug., 1955).

A simple relation between these is derived which permits an evaluation of the former without the need of accurate density measurements. W. Good

532.13 : 539.133

949. ON THE INTERNAL VISCOSITY OF CHAIN-LIKE MACROMOLECULES. R.Cerf.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 496-8 (Aug. 1, 1955). In French.

The arguments of a previous paper (Abstr. 3476/1955) are carried further by distinguishing between rotation and deformation of a large molecule. Two limiting cases are arrived at, corresponding to completely rigid and non-rigid molecules respectively. P.Cucka

532.133

950. TEMPERATURE DEPENDENCE OF VISCOSITY AND ITS RELATION TO VAPOR PRESSURE FOR ASSOCIATED LIQUIDS. L.A.Girifalco.
J. chem. Phys., Vol. 23, No. 12, 2446-7 (Dec., 1955).

A theoretical equation for the relation between temperature and viscosity is derived on the assumption that a molecule possesses two types of force centres one of which involves dipole interactions and the other dispersion forces. Experimental data for water and ethyl alcohol (both associated liquids) are satisfactorily accounted for. W.Good

532.137

951. THE HAGENBACH–COUETTE CORRECTION IN CAPILLARY VISCOMETRY. P.Tuomikoski.
Ann Acad. Sci. Fennicae AI, No. 189, 13 pp. (1955) In German.

Describes an experimental method of finding the correction to be applied to capillary viscometers in which the outlet is funnel shaped. The requisite theory and some typical results are given. H.G.Jerrard

532.14

952. THE DENSITY OF HEAVY WATER BETWEEN 95 AND 160°C. U.Grossmann-Doerth.
Z. Naturforsch., Vol. 10a, No. 9-10, 799-800 (1955). In German.

Values of the ratio of the densities of heavy to light water obtained using a pyknometer are tabulated at 5 deg. C intervals. The accuracy is given as $\pm$ 3 x 10^{-5}. S.Weintroub

532.52 : 535.557

953. STREAMING BIREFRINGENCE AS A HYDRODYNAMIC RESEARCH TOOL—APPLIED TO A ROTATING CYLINDER APPARATUS ABOVE THE TRANSITION VELOCITY. H.Wayland.
J. appl. Phys., Vol. 26, No. 10, 1197-205 (Oct., 1955).

Streaming birefringence was studied in the annular space between a fixed outer and a rotating inner cylinder at velocities on both sides of transition to Taylor vortex flow. With a well collimated light beam, quantitative measurements were possible as close as 0.1 mm from a wall. For an aqueous colloidal solution of bentonite, shear stress could be evaluated from birefringence measurements only when, for a given birefringence, the angle of extinction was the same in the unknown flow as in a known laminar flow. In turbulent shear flow this is not generally the case. For a pure liquid, ethyl cinnamate, the angle of extinction remained at 45° to the streamlines, within experimental error, under all flow conditions obtainable; thus even in turbulent shear flow the birefringence appears to arise primarily from the principal stresses. Assuming birefringence proportional to mean shear stress permits construction of a velocity profile across the gap, yielding the correct value of velocity of the moving wall within limits of experimental error. Thus in this type of two-dimensional shear flow the mean shear stress can be measured by means of the streaming birefringence of a pure liquid. A.

CAPILLARITY 532.6

532.61.08

954. DETERMINATION OF THE SURFACE TENSION OF RUBIDIUM FROM SURFACE DIFFUSION. H.Wegener.
Z. Phys., Vol. 143, No. 5, 548-58 (1956). In German.

From measurements of the rate of transport of material by surface diffusion (along a quartz substrate) from small to larger condensed drops of rubidium, the surface tension of this metal has been determined. The necessary equations are developed. The value of 77 $\pm$ 5 ergs/cm^2 found fits in very well with recent measurements of the surface tension of Li, Na and K (Abstr. 8947/1955); the reason for the great discrepancy between this value and that calculated from the electron theory of metals (50 ergs/cm^2) is discussed. R.C.Murray

532.65

955. ROTARY DEVICE FOR PRODUCING A STREAM OF UNIFORM DROPS. A.C.Rayner and W.Haliburton.
Rev. sci. Instrum., Vol. 26, No. 12, 1124-7 (Dec., 1955).

A rotary device was developed to produce uniform drops of liquids in the diameter range of 50 to 700 microns. A horizontally rotating blade detaches drops in a steady stream of regular trajectory, from a stabilized liquid mass fed under constant head through a stationary capillary. Its operation is described, and performance characteristics with oil and aqueous test solutions are given. Drop size is calculated from the mass of drops emitted in a given interval at a known generation frequency. Variation in size of individual drops, electrostatic effects, and some uses for the machine are noted. A.

532.65 : 541.18.051.3

956. OSCILLATING DROPLETS AND SPONTANEOUS EMULSIFICATION. D.A.Haydon.
Nature (London), Vol. 176, 839-40 (Oct. 29, 1955).

Following work on oscillating droplets by Lewis and Pratt (Abstr 4234/1954) the author has produced oscillation of pendant water drops and air bubbles in toluene by means of a capillary jet of acetone directed at the interface. It is shown that a necessary condition for oscillations is a nonuniform distribution of solute around the drops. It is concluded that spontaneous emulsification cannot however be related to this oscillation or kicking. T.C.Toye

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

957. LIQUID METALS. II. X-RAY DIFFRACTION BY LIQUID MERCURY AND THE DISTANCE OF CLOSEST ATOMIC APPROACH. J.S.Lukesh, W.H.Howland, L.F.Epstein and M.D.Powers.
J. chem. Phys., Vol. 23, No. 10, 1923-4 (Oct., 1955).

For Pt I, see J. phys. Chem., Vol. 57, 336 (1953). The distance of closest approach in mercury determined from vapour viscosity data, 3.25 A, differs considerably from the value found by X-ray and neutron diffraction studies on liquid Hg, 3.00 A. This X-ray value has been confirmed using a balanced filter-spectrometer technique and all the essential features of the intensity v. Bragg angle curve observed in previous studies have been verified except the low-angle peak reported by Campbell and Hildebrand. The discrepancy between the two r_0 values is attributed to the probable persistence of the asymmetrical structure known to exist in the solid into the

liquid phase, and its subsequent vanishing in the vapour state. A.

532.7

958. VARIATIONAL THEORY OF THE RADIAL DISTRIBUTION FUNCTION. J.M.Richardson.
J. chem. Phys., Vol. 23, No. 12, 2304-7 (Dec., 1955).

A variational approach to the calculation of the radial distribution function is presented. The approximations consist in the neglect of fourth-order correlation in the entropy and the use of a constant third-order correlation chosen to satisfy the third-order normalization condition. The average interaction energy, containing only pair terms, does not involve correlations higher than second order. Finally, one obtains approximate expression for the excess Helmholtz free energy as a function of the radial distribution function (r.d.f.) and macroscopic parameters. This free energy, when minimized with respect to the r.d.f. at constant temperature and density, yields an integral equation for the r.d.f. This theory has a simpler structure and yields thermodynamic functions in a more direct way than earlier theories. The theory has not yet been adequately tested; however, the author speculates that it will give good results for short-range forces but poor results for long-range forces. A.

532.7

959. A LATTICE THEORY OF QUANTUM FLUIDS. S.Koide.
J. Phys. Soc. Japan, Vol. 11, No. 1, 7-14 (Jan., 1956).

Using the procedure of "lattice space quantization", the cell method for liquids is developed quantum-mechanically so as to include the intercellular motion of the molecules. It is shown that quantum statistics plays its essential roles in this intercellular motion just as in the case of ideal gases. The ground state of the Bose liquid and the lambda-transition of liquid helium are discussed from this standpoint. A.

532.72

960. DIFFUSION COEFFICIENTS OF FATTY ACIDS AND MONOBASIC PHOSPHORIC ACIDS IN n-DECANE. J.R.White.
J. chem. Phys., Vol. 23, No. 12, 2247-51 (Dec., 1955).

Diffusion coefficients of the series of even-numbered fatty acids from C_6 to C_{18}, of three dialkyl phosphoric acids, and of 2-ethylhexoic and benzoic acids have been measured in dilute solutions in n-decane at 30°C. Gravity mixed diaphragm cells were employed in making the measurements. The Stokes–Einstein hydrodynamic relationship adjusted by an empirical coefficient represents the magnitude and variation of diffusion coefficients in the series of fatty acids if corrections are made for solute association and non-sphericity. The unmodified Stokes–Einstein equation predicts diffusion coefficients lower than those measured by approximately a factor of two. A.

532.783 : 548.737

961. SCATTERING OF X-RAYS BY A NEMATIC LIQUID SINGLE CRYSTAL. J. Falgueirettes.
C.R.Acad. Sci. (Paris), Vol. 241, No. 1, 71-3 (July 4, 1955). In French.

p-Azoxyanisol was orientated at 116°C either by placing it between vibrating parallel plates or by means of a magnetic field. The scattered X-rays showed a diffuse maximum of intensity, indicating the presence of layers of molecules with periodicity 4.4 A. A.R.Stokes

532.783 : 548.737

962. DISTRIBUTION OF MOLECULES, IN A LIQUID SINGLE CRYSTAL, OBTAINED FROM MEASUREMENTS OF THE SCATTERING OF X-RAYS. J. Falgueirettes.
C.R. Acad. Sci. (Paris), Vol. 241, No. 2, 225-7 (July 11, 1955). In French.

See preceding abstract. The results are analysed in an attempt to deduce the orientation and distribution of the molecules around the isotropic axis. A function is obtained which relates the number of molecules having a given orientation with the intensity of the scattered beam within a small solid angle. The results agree with deductions made from measurements of refractive indices. J.Iball

532.785

963. SEPARATION OF IONS AT CRYSTALLIZATION OF WATER. R.Brill and H.Ender.
Nature (London), Vol. 176, 925 (Nov. 12, 1955).

Hydrogen fluoride ions are incorporated in ice on freezing one half of a diluted solution of caesium fluoride. The pH of the remaining liquid is higher than that of the thawed ice. The replacement causes a disturbance by missing hydrogen bonds. C.Turner

MECHANICS OF GASES 533

533.16 : 537.223.1

964. AIR RESISTANCE OF ROTATING CIRCULAR DISKS. W.Herchenbach.
Z. Naturforsch., Vol. 10a, No. 9-10, 741-4 (1955). In German.

The attempt to improve the efficiency of rotating-disk, electrostatic high-voltage generators, led to this investigation. Measurements of frictional losses at Reynold numbers of 10^5-10^6, carried out in air, are described. The results differ from those previously reported, and reasons for the discrepancies are suggested. Some further measurements were made, with a second, adjacent disk, which could be kept stationary or rotated in the opposite direction. The results led to a design for a generator, operating in water vapour at high pressures, in which the frictional losses amounted to less than 2% of the output. E.A.Ash

533.21 : 539.893

965. SHOCK WAVES PRODUCED IN LIQUID ARGON AND THEIR STUDY BY ULTRA-RAPID RADIOGRAPHY. COMPRESSION OF ARGON UNDER VERY HIGH PRESSURES. J.Dapoigny, J.Kieffer and B.Vodar.
J. Phys. Radium, Vol. 16, No. 8, 733-5 (Aug.-Sept., 1955). In French.

Illustrations are given of the initiation and propagation of shock waves in liquid argon contained in a Dewar flask made of Plexiglass surrounded by liquid nitrogen; the photographs were taken by ultra-rapid radiography lasting 2.5 microsec. Values of the compressibility of argon at pressures up to 75 000 kg/cm² are represented graphically. It is considered that the temperature in the shock wave in liquid argon rises rapidly, the 55°C isotherm being cut at a pressure of about 15 000 kg/cm². The specific heat of liquid argon at normal pressure (1.1 joule/g) is much less than that of water (4.2 joule/g). As the critical temperature of argon is about −122°C, the experimental results suggest that the argon used is in the supercritical state. J.S.G.Thomas

533.21 : 539.893

966. EQUATION OF STATE FOR ARGON AT VERY HIGH PRESSURE AND ITS COMPRESSIBILITY IN A SHOCK WAVE. R.Bergeon, J.Kieffer and B.Vodar.
J. Phys. Radium, Vol. 16, No. 10, 813-14 (Oct., 1955). In French.

Extrapolation of Bridgman's measured isotherms for argon to the pressure prevailing in shock waves is best made on the basis of Lennard-Jones' and Devonshire's fluid theory (Proc. Roy. Soc. A, Vol. 163, 53, 1937) from Wentorf's calculations (Abstr. 2648/1951) using b_0 = 59.5 cm³/mole instead of the usual value of 50.4. The temperatures derived from a comparison of these calculated pressure isotherms with the experimental adiabatic agree within the experimental error

with those derived from a comparison of the theoretical internal energy isotherms with the experimental internal energy curve worked out from the Hugoniot equation. It is suggested that the study of shock waves in liquefied gases is a simple method of studying highly compressed gases. R.C.Murray

533.275

967. SIMPLE HUMIDITY LAG APPARATUS.
S.Hasegawa, S.B.Garfinkel and A.Wexler.
Rev. sci. Instrum., Vol.26, No. 12, 1196-7 (Dec., 1955).

A simple apparatus for producing humidity step-functions at room temperature, using saturated salt solutions to maintain constant relative humidities, is described. For an air flow of 200 l. per min, the time required to change from one relative humidity to another is of the order of 30 to 50 milliseconds. This apparatus is particularly useful for establishing the lag characteristics of hygrometer elements. A.

533.41

968. A NEW NORMAL BAROMETER. E.T.Levanto.
Ann. Acad. Sci. Fennicae AI, No. 191, 14 pp. (1955).

Details of construction of the barometer housed at the Institute of Meteorology, University of Helsinki, are given with the results of a series of comparisons with standard types of barometers. The main features are: glass tubes of inner dia. 32 mm to avoid capillary depression errors; a permanently connected small McLeod gauge to check the air pressure in the vacuum; an iron index; a wooden scale of thermal expansion coefficient 2.7×10^{-6} per deg. C; air thermostatting and an estimated accuracy of 0.01 mm of mercury. S.Weintroub

533.41

969. TWO-FLUID BAROMETER AS A STUDENT PROJECT.
C.Williamson.
Amer. J. Phys., Vol. 23, No. 8, 492-4 (Nov., 1955).

The two-fluid barometer, invented by Descartes and constructed by Huygens, has been undeservedly neglected. It combines almost the compactness of the mercury barometer with almost the sensitiveness of the water barometer. Two patterns, the straight-tube and the J-tube, are described in this paper. Reasons for preferring the J-tube pattern are given. Neither pattern requires more than routine glassblowing skill. The two fluids may be mercury and butyl phthalate. Instructions for filling the barometer are included. The finished instrument is a good teaching piece and is interesting to the general public, but it is not recommended as a replacement for the standard mercury barometer when highly accurate readings are needed. A.

533.5

970. EXPERIMENTS AT VERY LOW PRESSURES.
D.Alpert.
Science, Vol. 122, 729-33 (Oct. 21, 1955).

Reviews briefly recent developments and techniques (Abstr. 8274/1953, 6350/1954) which enable the attainment of pressures as low as 10^{-10} mm Hg without refrigerants or chemical getters, and the types of investigations opened up by this new ultra-high vacuum technology. A crucial requirement is that the entire high vacuum system should be capable of high-temperature bake out and an assembly consisting of a series of module units together with standard furnaces is described and illustrated. The limitations to the production of still lower pressures are discussed. It is shown that the entire residual pressure of $3\text{-}4 \times 10^{-11}$ mm Hg is due to diffusion of pure helium into the system through the Pyrex envelope, and various ways are discussed to reduce the ultimate pressure, for example, by enclosing one vacuum system inside another (Abstr. 117/1955) or by using an oil diffusion pump with a copper foil trap to prevent backstreaming of oil vapour without reduction of speed. Finally recent experiments on ion pumping are described. S.Weintroub

533.56

971. CONTRIBUTION TO THE THEORY OF DIFFUSION PUMPS. L.Zobač.
Slaboproudý Obzor, Vol. 16, No. 10, 541-9 (1955). In Czech.

It is postulated that the maximum pumping velocity is achieved at the lowest vapour pressure, at which the back diffusion of gases from output to input is still negligible. Evaluation of the optimum vapour pressure for these conditions is carried out on the basis of the mean free path of the gas molecules and by means of the diffusion equations. The first method leads to complicated expressions which, when simplified, become inaccurate, especially for the case of light gases. The second method gives only approximate formulae. The equations are employed to determine the optimum pressure in the first, second and third jets of a multi-stage pump. Expressions for the radius of the inlet tubes (from the boiler) to the jets in the standard and fractionating three-stage pumps are also derived; these also permit determination of the size of the jets and the diameter of the input aperture. An attempt is made to evaluate the heat absorbed by a diffusion pump. R.S.Sidorowicz

533.59

972. MODERN METHODS OF LEAK DETECTION.
L.E.Levina.
Uspekhi fiz. Nauk, Vol. 55, No. 1, 101-10 (1955). In Russian.

The paper has 30 references covering the last seven years, all to Western work. C.R.S.Manders

533.59

973. METAL GASKETS FOR DEMOUNTABLE VACUUM SYSTEMS. P.J.van Heerden.
Rev. sci. Instrum., Vol. 26, No. 12, 1130-1 (Dec., 1955).

Two different constructions were investigated of copper gasket seals for a demountable vacuum system. These were 5½ inches in diameter and with both a leak rate lower than 10^{-6} microlitre/sec could be obtained. A.

533.6.011

974. SOLUTIONS OF HYDRODYNAMIC EQUATIONS WITH LINEAR VELOCITY DEPENDENCE. S.v.Hoerner.
Z. Naturforsch., Vol. 10a, No. 9-10, 687-92 (1955). In German.

On the assumption that velocity is a linear function of the coordinate in one-dimensional gas flow, a general solution is obtained, which is shown to yield three general types and three special cases. As an example, a solution is obtained for a strong shock wave, which is exact for gases with a ratio of specific heats of 7/5 (5 degrees of freedom), and gives a good approximation for the region upstream of the shock wave for gases with a ratio of specific heats of 5/3 (3 degrees of freedom). The case of isentropic flow into vacuum investigated previously by Burgers (Abstr. 2296/1946) is another example of linear velocity dependence. A.Gelbtuch

533.6.011 : 534.222.2

975. THE PRODUCTION OF POWERFUL SHOCK FRONTS (IN BLAST-WAVES) IN HOMOLOGOUS SOLUTIONS.
F.Meyer.
Z. Naturforsch., Vol. 10a, No. 9-10, 693-7 (1955). In German.

Powerful, plane, non-stationary, shock fronts, generated and propagated in a gas at rest, are, in the neighbourhood of their blast-fronts, compared with homologous solutions, and the observed tendency of solutions, generally, under the influence of such impact, to acquire a definite homology, is discussed analytically (see Abstr. 8109/1954). J.S.G.Thomas

533.6.011.3

976. THE APPLICATION OF MEKSYN-IMAI'S METHOD TO THE SUBSONIC FLOW PAST AN AXISYMMETRIC BODY.
K.Kusukawa.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1088-92 (Dec., 1955).

A procedure is developed analogous to Meksyn-Imai's method, which was offered for the two-dimensional irrotational flow of a compressible fluid. It is then proved that the final results obtained in the two-dimensional case can also be used in the present three-dimensional case. As an example the flow past a sphere is discussed. A.

533.6.011.3

977. ON THE SUBSONIC FLOW OF A COMPRESSIBLE FLUID PAST AN AXISYMMETRIC MODERATELY THICK BODY. K.Kusukawa.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1093-101 (Dec., 1955).

Introducing new variables, the fundamental equations for compressible fluid flow in the hodograph space are reduced to a form similar to that for incompressible fluid flow. As examples the velocity distributions on the surface of a sphere and prolate spheroids with thickness ratio t = 0.9 and 0.1 are calculated for various Mach numbers, and they are compared with the results obtained by the M^2-expansion method, Meksyn-Imai's method and the linear theory. A.

533.6.013

978. STABILITY AND STABILIZATION OF AERODYNES. L.Frager.
J. Phys. Radium, Vol. 16, No. 18, 712-18 (Aug.-Sept., 1955). In French.

Uncertain air velocities (turbulence etc.) associated with the motion of an aerodyne are discussed from the point of view of a statistical relation embracing the global matrix of the operation of the aerodyne and the spectral correlation tensors of the respective velocities of air and aerodyne. The matrix relation is derived from the interdependence of the harmonic components of the air motion and those of the aerodyne motion provided with an automatic pilot. The spectral tensor of the aerodyne motion is easily derived from the spectral tensor of the accelerations which can be easily measured by the use of optical recorders. J.S.G.Thomas

MOLECULAR THEORY OF GASES 533.7

533.7

979. QUANTUM MECHANICAL DERIVATION OF THE BOLTZMANN EQUATION. H.Kümmel.
Z. Phys., Vol. 143, No. 2, 219-32 (1955). In German.

The Boltzmann transport equation is derived from the equations of motion in both classical and quantum theory. Special attention is paid to the way in which the assumption of "molecular chaos" leads to the appearance of a preferred time direction in the theory. E.H.Sondheimer

533.7

980. DYNAMICS OF RAREFIED GASES. M.Krook.
Phys. Rev., Vol. 99, No. 6, 1896-7 (Sept. 15, 1955).

The kinetic model (Abstr. 6360/1954) leads to a non-linear collision equation, which corresponds to the Boltzmann equation. The one dimensional problem with suitable boundary conditions can be transformed into integral equations, giving rapidly converging solutions by successive approximations. A more detailed account, together with the results of calculations, is to be published. F.Ansbacher

533.7 : 536.71

981. NOTE ON IMPERFECT GAS THEORY. F.E.Harris.
J. chem. Phys., Vol. 23, No. 10, 1965 (Oct., 1955).

A simple method is given for deriving the equation of state in the virial form, expressed in terms of the irreducible cluster integrals β_l, from the equation of state in terms of the cluster integrals b_l. E.H.Sondheimer

533.7 : 537.525

982. A CRITICAL EXAMINATION OF THE THEORY OF PLASMAS BASED ON THE MEAN-FREE-PATH CONCEPT, IN THE LIGHT OF THE METHOD BASED ON THE DISTRIBUTION FUNCTION OBTAINED BY SOLVING THE BOLTZMANN EQUATION. R.Jancel and T.Kahan.
J. Phys. Radium, Vol. 16, No. 11, 824-8 (Nov., 1955). In French.

The inadequacy of the mean-free-path method is demonstrated by discussion of various examples in the theory of conduction in ionized gases subjected to electric and magnetic fields. E.H.Sondheimer

533.7 : 541.183

983. NEW MODEL FOR A TWO-DIMENSIONAL STANDARD STATE. H.L.Harter, P.R.Rider and P.M.Williamson.
J. chem. Phys., Vol. 23, No. 10, 1966-7 (Oct., 1955).

The proposed standard state is one in which the adsorbed molecules have a "freedom of movement" equal to that in the bulk gas at 1 atmosphere pressure. This leads to a simple relationship between the two-dimensional and the three-dimensional pressure. S.J.Gregg

533.75 : 536.71

984. HIGH-TEMPERATURE EQUATION OF STATE BY A PERTURBATION METHOD. II. POLAR GASES. R.W.Zwanzig.
J. chem. Phys., Vol. 23, No. 10, 1915-22 (Oct., 1955).

The perturbation theory described in Pt I (Abstr.9220/1954) is applied to the calculation of the equation of state at high temperature of a polar gas. The electrostatic dipolar potential is considered to be a perturbation on the nonpolar Lennard-Jones potential. The dipole contribution to the equation of state is expressed in terms of properties of the unperturbed system. These properties are obtained from experimental data on argon and xenon. Numerical tables of the reduced equation of state of the polar gas, over a wide temperature and density range, are presented. The theory is tested on water vapour and on methyl fluoride. Theoretical predictions of the pressure agree with experimental data over a wide density range (up to 0.25 g/cm^3 for water) to within several per cent. A.

VIBRATIONS. ACOUSTICS 534

534.121.1

985. ON UPPER AND LOWER BOUNDS OF THE EIGENVALUES OF A FREE PLATE. Y.Nakata and H.Fujita.
J. Phys. Soc. Japan, Vol. 10, No. 9, 823-4 (Sept., 1955).

A preliminary note concerned with the vibration of a thin elastic plate in the xy plane bounded by a sufficiently regular contour. The case of a square plate vibrating with a nodal line coincident with two coordinate axes is treated as a numerical example. W.Bardsley

534.121.1

986. VIBRATIONS OF SIMPLY SUPPORTED ISOSCELES TRAPEZOIDAL FLAT PLATES. B.Klein.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1059-60 (Nov., 1955).

Solutions are given for the lowest natural frequency of flexural vibration of isosceles trapezoidal flat plates which have simply supported edges. The results of the calculations are presented graphically so that one may determine rapidly a desired fundamental frequency. The range of the values of the geometric parameters defining the plate is large enough to cover most practical cases. A.

534.121.2 : 534.232

987. STUDY OF THE AIR LAYER BETWEEN A CIRCULAR MEMBRANE AND A PLANE ELECTRODE. I. C.Colin.

J. Phys. Radium, Vol. 16, No. 11, 863-7 (Nov., 1955). In French.

A theoretical examination of the fundamentals of the problem indicates that the action of the air layer may be isolated by placing the membrane between two symmetrical electrodes, thus giving a system capable of analysis by electromechanical means. H.J.H.Starks

534.121.2 : 534.232

988. STUDY OF THE AIR LAYER BETWEEN A CIRCULAR MEMBRANE AND A PLANE ELECTRODE. II. C.Colin.
J. Phys. Radium, Vol. 16, No. 11, 868-73 (Nov., 1955). In French.

The transfer function as a function of frequency is obtained by substituting the pulsatance ω by a complex pulsatance ω^*, the real and imaginary parts of which are parametric functions of ω. A single parameter P is derived, and curves representative of the image of ω^* as a function of frequency are given for variations in the parameter P; these enable the effect of alterations in the shape of the electrodes to be predicted. H.J.H.Starks

534.141.4 : 532.527

989. STRUCTURE AND VELOCITY OF THE PERIODIC VORTEX-RING FLOW PATTERN OF A PRIMARY PFEIFENTON (PIPE TONE) JET. A.B.C.Anderson.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1048-53 (Nov., 1955).

Visualization of the vortex flow pattern in typical primary Pfeifenton jets was made by means of shadowgraph techniques to show the transition in form of the vortex pattern as it moves downstream in the jet, as well as, the dependence of the downstream translational vortex velocity and the geometry of the vortex pattern on the Reynolds number of the jet. Results of experiment are compared with available theory. These studies were carried out with carbon dioxide jets discharging into the atmosphere. The flow channel geometry consisted of a pipe $\frac{7}{8}$ in. in diameter, 12.013 in. long effectively, open at one end, which was inserted into a large stilling tank and terminated at the other end of an orifice plate containing a sharp-edged circular orifice, 0.250 in. in diameter and 0.093 in. thick. A.

534.21 : 621.383

990. ON MAKING (ULTRA-) SOUND VISIBLE USING AN ELECTRON-OPTICAL IMAGE CONVERTER. M.von Ardenne.
Nachrichtentechnik, Vol. 5, No. 2, 49-51 (Feb., 1955). In German.

Present methods for the visible demonstration of ultrasonic energy distribution are summarized, and a medical requirement indicated for the more sensitive and convenient means proposed: sound energy incident on an absorbing layer produces a corresponding distribution of temperature and hence of cold emission from the attached photo-cathode of low work function. It is estimated that with 20 kV acceleration to a fluorescent screen an image could be produced sensitive to 0.1 W/cm^2 of incident sound at a frequency of 5 Mc/s. Design and materials are suggested for the special image converter required. A.Reddish(R)

534.213 : 535.42

991. SIMPLE WAY TO OBSERVE OPTICAL DIFFRACTION PATTERNS PRODUCED BY SHEAR WAVES. M.A.Breazeale and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1220-1 (Nov., 1955).

The diffraction pattern due to shear waves in glass can be observed in the absence of compressional waves by submerging the glass in a liquid and exciting the shear waves by means of ultrasonic waves in the liquid impinging on the glass at an angle larger than the critical angle for longitudinal waves. A.

534.22

992. NOTE ON THE PAPER BY L.Y.TU, J.N.BRENNAN AND J.A.SAUER ON DISPERSION OF ULTRASONIC PULSE VELOCITY IN CYLINDRICAL RODS. M.C.Junger.
J. Acoust. Soc. Amer., Vol. 27, No. 5, 974 (Sept., 1955).

The authors concluded that when the frequency is large, i.e. when the ratio of rod radius (a) to wavelength (λ) is large, an elastic pulse propagates in a cylindrical rod at the dilatational velocity of the material. It is argued that when the configuration of the transducer is such as to excite only one particular mode of vibration at a given value of a/λ, other modes will be excited if a pulse is used, because the velocity distribution of the particular mode will no longer conform to the transducer configuration for the values of a/λ corresponding to the other frequencies in the pulse. Thus, a number of group velocities are excited corresponding to different pulse frequency components and to different modes. The lowest longitudinal mode of propagation has a phase velocity which, with increasing frequency, approaches that of the Rayleigh surface wave. The higher modes are characterized by a high-pass cut-off frequency and each has a dispersion curve which, with increasing frequency, drops rapidly to the dilatational velocity where it forms a level plateau over a certain frequency range. After this, the curve drops to the distortional velocity. It is concluded that the results obtained by the authors therefore do not conflict with previous analytical work provided allowance is made for recent studies of the higher modes of propagation. A.C.Whiffin

534.22

993. DETERMINATION OF THE VELOCITY OF SOUND IN HYDRAZINE–WATER MIXTURES BY MEANS OF THE DEBYE–SEARS ULTRASONIC LIGHT DIFFRACTION PHENOMENON. G.G.Kretschmar.
J. chem. Phys., Vol. 23, No. 11, 2102-4 (Nov., 1955).

The velocity of sound has been determined at 4 Mc/s for a large number of different concentrations of hydrazine in water from 8 to 99 weight % of hydrazine. The velocities were determined from the diffraction of a monochromatic light beam which was projected through a glass-sided cell containing the liquid in which standing waves were set up by an oscillating quartz crystal. The light source was a sodium arc and the frequency of the ultrasonic wave train was determined with a precision frequency meter. The diffraction angles were measured on a Gaertner spectrometer, reading to one second of arc. The data can be represented by the equation

$$V = 1497.40 + 745.460H + 382.353H^2 - 556.3361H^3,$$

where V is the velocity of sound in the hydrazine-water mixture at 25° C and H is the fractional weight of hydrazine. A.

534.22 : 541.64

994. ON THE DISCONTINUITY IN THE TEMPERATURE COEFFICIENT OF THE VELOCITY OF ULTRASONIC WAVES IN POLYMERIC MATERIALS. R.N.Work.
J. appl. Phys., Vol. 27, No. 1, 69-72 (Jan., 1956).

It is proposed that the discontinuity is a manifestation of the sudden change in the expansion coefficient that occurs at the glass-transition temperature. A comparison of volume-temperature data with velocity-temperature and velocity-pressure data taken from the literature gives reasonably good agreement with this explanation. Further, the dependence of velocity on density is seen to be chiefly through the strong dependence of the modulus on density and to a lesser extent through the appearance of density explicitly in the equation that relates velocity to the density and modulus. A.

534.221

995. NOTE ON THE DERIVATION OF THE EQUATION $v = \sqrt{(T/\mu)}$. H.S.C.Chen.
Amer. J. Phys., Vol. 23, No. 9, 588-9 (Dec., 1955).

A simple, straightforward derivation is given for the speed of a transverse wave along a stretched string. It is free from the many limitations and assumptions which are generally found in other derivations. The only assumption which has to be made is that the wave travels with a constant speed and small amplitude. A.

534.222.2

996. ON EXACT SOLUTION OF THE BLAST-WAVE PROBLEM. A.Sakurai.
J. Phys. Soc. Japan, Vol. 10, No. 9, 827-8 (Sept., 1955).

It is shown that the method used by J.L.Taylor to obtain an exact solution of the equations of the initial stage of a spherical blast-wave, starting at a point source, (Abstr. 513/1955), is applicable to the corresponding problems involving cylindrical or plane blast-waves. J.S.G.Thomas

534.222.2

997. DECREMENT OF BLAST-WAVES. A.Sakurai.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1018 (Nov., 1955).

Measured values of the decrement of the shock-front of blast waves and values calculated by Wolff's experimental formula and from an approximate theory, are compared graphically. J.S.G.Thomas

534.222.2 : 539.132 : 533.75

EQUATION OF STATE OF GASES BY SHOCK WAVE MEASUREMENTS. See Abstr. 134.

534.23 : 532.7

998. ABSORPTION OF ULTRASONICS IN LIQUID MIXTURES. K.Eppler.
Z. Naturforsch., Vol. 10a, No. 9-10, 744-52 (1955). In German.

Absorption maxima have been found by W.Maier and A.Mez (Abstr. 5281/1955) for CCl_4 and cyclohexane–phenol mixtures at low phenol concentrations. This work, which covers fifteen other systems shows that the maximum diminishes with increasing mutual exchange between solvent and OH groups (of the alcohol) and at the same time moves towards higher alcohol concentration. It is concluded that the relation of these maxima to relaxation processes is difficult without complete knowledge of the frequency dependence of absorption over a wide frequency range. T.C.Toye

534.23 : 532.7

999. A NEW PULSE METHOD TO MEASURE ULTRASONIC ABSORPTION IN TRANSPARENT LIQUIDS. A.Çilesiz.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 20, No. 2, 94-112 (April, 1955).

To measure ultrasonic absorption by the pulse method, quartz crystals are generally used as transducer and receiver. In this work, the receiver is simplified by using the light diffraction produced by the ultrasonic wave packet. The diffracted light-pulses fall on a photomultiplier, the output of which is connected directly to an oscillograph. The conditions for getting proper results for the coefficient of absorption α are discussed. The method has been checked for water for which accurate measurements can be found in the literature. Agreement exists with the values found by Fox and Rock (1940) and by Sette (1950). The results are lower by 19% than those found by Pinkerton (1949). Measurements have also been made under the same conditions in toluol, for which the value $(\alpha/f^2) = 72 \times 10^{-17}$ cm^{-1}. sec^2 has been found for 22° C and 28° C. A.

534.23 : 532.7

1000. ABSORPTION OF ULTRASONIC WAVES IN ORGANIC LIQUIDS. III. LIQUIDS WITH NEGATIVE TEMPERATURE COEFFICIENT OF SOUND ABSORPTION (b) o-CHLOROPHENOL AND ANILINE. T.Kishimoto and O.Nomoto.
J. Phys. Soc. Japan, Vol. 10, No. 11, 933-6 (Nov., 1955).

For Pt II, see Abstr. 2516 (1955). The ultrasonic absorption coefficient (at 15-20 Mc/s) in o-chlorophenol and aniline decreases with temperature rise. The excess absorption obtained by subtracting the classical absorption from the observed one is nearly independent of temperature for both liquids and is ascribed to the molecular absorption. The absorption due to bulk viscosity, if present, is small, and estimated to be less than $\frac{1}{2}$ the classical absorption due to shear viscosity. A

534.23 : 532.74

ULTRASONIC ABSORPTION IN MIXTURES OF ORGANIC LIQUIDS. See Abstr. 122.

534.23 : 537.312.62

1001. RELATIVE ABSORPTION OF 10 Mc/sec LONGITUDINAL SOUND WAVES IN A SUPERCONDUCTING POLYCRYSTALLINE TIN ROD. L.Mackinnon.
Phys. Rev., Vol. 100, No. 2, 655-9 (Oct. 15, 1955).

The relative absorption of 10 Mc/s sound pulses has been studied between 1.5°K and 3.73°K (the transition temperature) in superconducting polycrystalline tin and above 3.73°K to about 4.2°K in the normal metal. Above the transition the absorption was heavy, but below it, the absorption decreased considerably as the temperature was lowered. It was possible to estimate how the minimum value of the absorption coefficient (which differed from the true value by an undetermined constant equal to the absorption coefficient at the absolute zero of temperature) varied as a function of temperature, but no success has yet been achieved in correlating this quantitatively with existing theories of superconductivity or of absorption of sound in metals at low temperatures. A.

534.23 : 537.312.62

1002. ULTRASONIC ATTENUATION IN SUPERCONDUCTING AND NORMAL-CONDUCTING TIN AT LOW TEMPERATURES. H.E.Bömmel.
Phys. Rev., Vol. 100, No. 2, 758-9 (Oct. 15, 1955).

99.998% tin single crystals show at 10.3 Mc/s an attenuation which is, at its maximum value (at the transition temperature), 100 times larger than that of a 99.98% crystal. In the purer sample the attenuation in the normal state is substantially decreased by magnetic fields of a few hundred oersted. This is ascribed to the magnetoresistive effect which is appreciable at the high conductivities (about 10^{10} ohm^{-1}.cm^{-1}) involved. The attenuation v. field curve in a transverse field shows a dip at 200 oersted. In a shorter sample this dip occurs also in a longitudinal field and shifts to higher fields in proportion to the frequency. See also Abstr. 969 and 2518 (1955). H.London

534.232

1003. THE PERFORMANCE OF A QUARTZ OSCILLATOR IN LIQUIDS. I. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 143, No. 3, 300-11 (1955).

Experiments are described to measure the ultrasonic output from a quartz transducer by a calorimetric method. The electrical input power has also been estimated. The efficiency of conversion is examined in the light of available physical data for several liquids. A.

534.232

1004. THE PERFORMANCE OF A QUARTZ OSCILLATOR IN LIQUIDS. II. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 143, No. 5, 623-31 (1956).

In this paper the efficiency of conversion is examined in relation to the sound absorption coefficient of the liquids. A.

534.232 : 537.228.1

PIEZO CRYSTALS USED AS ULTRASONIC TRANSDUCERS. See Abstr. 315.

534.232 : 621.395.623.7

1005. DESIGN AND PERFORMANCE OF A HIGH-FREQUENCY ELECTROSTATIC SPEAKER. L. Bobb, R.B.Goldman and R.W.Roop.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1128-33 (Nov., 1955).

An electrostatic speaker has been developed which provides a high quality of h.f. reproduction not available with electromagnetic tweeters. The diaphragm consists of a thin plastic film bearing an evaporated metallic layer. The membrane is stretched around a semicylindrical perforated electrode on which ridges are embossed to provide clearance.

The response varies less than ±2 db in the frequency range between 8 and 16 kc/s. The azimuthal distribution pattern is excellent, owing to the cylindrical geometry, and is essentially independent of frequency in the same range. The second harmonic distortion inherent in this type of speaker is maintained at a low value. An indication of the quality of h.f. reproduction is provided by oscillograms of the response to tone burst signals. The speaker is in quantity production and has been incorporated in several models of home reproduction instruments. A.

534.321.7

1006. ABSOLUTE PITCH. A.Bachem.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1180-5 (Nov., 1955).

The author, who possesses absolute pitch, amused by the fact that the most extensive work on "absolute pitch" was conducted by psychologists who did not possess this faculty and that it was done on large groups of students, none of whom possessed this faculty either (For exception see O.Abraham, Sammelbde d. Internat. Musikges, 3, 1, 1901, and G.Révész, Zur Grundlegung der Tonpsychologie, Leipzig), was convinced that a study by a possessor of absolute pitch on himself and on a large number of other possessors of absolute pitch might lead to different and better results. An original study (A. Bachem, J. Acoust. Soc. Am. 9, 146, 1937) was conducted on 96 possessors of absolute pitch, and 7 more or less musical persons without this faculty for comparison. The work was extended in the course of time to specific related problems which presented themselves through several discoveries. A.

534.37

1007. MEASUREMENTS UPON DAMPING MATERIALS. C.B.Sacerdote.
R.C. 55 Riun Assoc. Elettrotec. Ital., Bellagio, 1954, Vol. 42, Fasc. 2, Paper 162, 8 pp. (1955). In Italian.

A brief description of the vibration technique used, and a review of the work of other authors, are given. The parameters involved are defined, and their experimental behaviour and the results obtained are discussed in detail, using graphs of the functions. Oscillographs and photographs of the higher modes of vibration of square plates are included. J.J.Phipps

534.6

1008. MEASUREMENT OF CORRELATION COEFFICIENTS IN REVERBERANT SOUND FIELDS. R.K.Cook, R.V.Waterhouse, R.D.Berendt, S.Edelman and M.C.Thompson, Jr.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1072-7 (Nov., 1955).

Reverberation chambers used for acoustical measurements should have completely random sound fields. If R denotes the cross-correlation coefficient for the sound pressures at two points a distance r apart, then

$$R = \langle p_1 p_2 \rangle_{Av} / (\langle p_1^2 \rangle_{Av} \langle p_2^2 \rangle_{Av})^{\frac{1}{2}},$$

where p_1, is the sound pressure at one point, p_2 that at the other, and the angular brackets denote long time averages. In a random sound field, $R = (\sin kr)/kr$, where $k = 2\pi/$(the wavelength of the sound). An instrument for measuring and recording R as a function of time is described. A feature of this instrument is the use of a recorder's servomechanism to measure the ratio of two d.c. voltages. The results of correlation measurements in reverberant sound fields are given. A.

534.612

1009. USE OF A BIFILAR AS A BALANCE TO MEASURE THE PRESSURE OF SOUND RADIATION. G.Laville.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 465-7 (Aug. 1, 1955). In French.

A description is given of a bifilar suspension supporting a small magnet and a concave mirror, which can be used to measure the pressure of sound radiation. Two radial-sliding permanent magnets serve to control the field at the suspended magnet, and a pair of auxiliary Helmholtz coils produce a small additional control field. The torque can be measured either by a torsion head or by the magnetic control. A.B.Wood

534.612 : 551.46.018

1010. FLUCTUATIONS IN INTENSITY OF SHORT PULSES OF 14.5-kc SOUND RECEIVED FROM A SOURCE IN THE SEA. F.H.Sagar.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1092-106 (Nov., 1955).

Some 4000 measurements of acoustic pressure obtained from experiments (using 1.3-millisecond pulses), in which resolution was achieved between direct and echo pulses, are reported. Of the usual causes producing fluctuation, many were either eliminated or corrected for. Transducer oscillations of the linear and rotational types remained, together with attenuation changes due to temperature-microstructure effects. Two ships were employed, both multianchored to ensure range constancy, work being restricted to conditions of low sea-state and to ranges of from 70 to 500 yards. The depth of the projector and the hydrophones were respectively 60 and 45 ft. The area selected was about 50 miles from the mainland of the North Island of New Zealand and here only small streams drain from the coast into the sea. Work was performed in a 130-foot patch of secluded water between a few steep rocks and islands, the drainage from the latter also being negligible. Fluctuation from signal to signal was small, the largest value of the ratio "maximum pressure to minimum pressure" for the longest experiment (85 minutes) being 1.94 while the variation coefficients for 48 separate pulse sequences relating to a variety of conditions fell in the range 5.0% to 12.4%. No clear correlation was found to exist between fluctuation and range, transducer depth or tidal current, but some correlation existed with sea-state. Percentage deviations from the average pressure-signal value per hydrophone, gave histograms, for any one experiment, which are approximately Gaussian in shape, the largest value of deviation encountered being plus 40%. Histograms constructed from data from selected hydrophones possessing identical spatial irregularities have a modified shape consistent with the conclusion that fluctuation is here entirely due to continuous transducer rotations about the suspension cables. A.

534.62

1011. SIMPLE ANECHOIC TANK FOR UNDERWATER SOUND. W.J.Toulis.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1221-2 (Nov., 1955).

The walls of an underwater sound tank may be made highly absorptive by using thin SOAB wedges to minimize the mismatch at the interface. The performance of an experimental tank has been highly effective at frequencies as low as 10 kc/s. Design and maintenance problems have been very simple. A.

534.64 : 612.85

1012. MECHANICAL IMPEDANCE OF THE FOREHEAD AND MASTOID. E.L.R.Corliss and W.Koidan.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1164-72 (Nov., 1955).

A method has been developed for determining the resistive and reactive components of the impedance of the human head and mastoid, or of other high mechanical impedances, using a special direct-recording measuring system that records both force and motion. Impedances presented to driving tips of 12.5 and 20 mm diameter have been measured over the audio-frequency range from 40 to 10 000 c/s. The effects of static force coupling the head to the driver have been compared for 500 and 1000 g coupling forces. Over a large part of the audio-frequency range, the predominant characteristic of both head and mastoid impedance is a stiffness reactance, with some damping. In the high-frequency range, a small mass reactance parameter appears. The mass load due to the whole head influences the impedance only at the low frequency extreme of the measurement range. The driving sys-

tem consisted of a tubular section of polarized barium titanate, rigidly clamped at one end to a massive wall. Force and motion were measured close to the point of contact with the load, to minimize errors arising from flexure in the driver or between the sensing elements. The system was calibrated by loading the driving tip with known masses. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

1013. EFFECTS OF RESPONSE COMPLEXITY UPON LISTENING TO COMPETING MESSAGES. J.C.Webster and L.N.Solomon.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1199-203 (Nov., 1955).

Three groups of twelve men listened to sequences of two, three, or four competing messages. They listened under four different conditions, two conditions of filtering (filters in — filters out) and two conditions of spatial separation (channels split — channels together). They responded on certain occasions to one message of the set and at other times to two messages. The first group wrote down, in simple symbols, the content of the message(s) whose address(es) they were to guard. The second group spoke the content of the assigned messages to a partner who wrote it down. The third group transposed (decoded) the message content before writing it down. The results show that (1) more than twice as many errors occurred when responding to two instead of one message, (2) whether responding to one or two messages, transposing or talking produced an increase in frequency of errors of 10% over writing, and (3) errors increased as the listening condition changed from Filtered-Split to Unfiltered-Split to Filtered-Together to Unfiltered-Together. A.

534.78

1014. DIFFERENCE LIMEN FOR THE INTENSITY OF A VOWEL SOUND. J.L.Flanagan.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1223-5 (Nov., 1955).

An exploratory experiment to determine just discriminable differences in the intensity of a synthetic vowel sound is described. Results of AB listening tests performed with intra-sample time spacings of 0.5, 1.0 and 1.5 seconds are given. The median value of the DL for vowel intensity obtained from the tests is 1.5 db, and the DL is never less than 1.2 db. Tentative data on the time error for a vowel sound are noted and compared to similar data for pure tones. A.

534.781 : 534.415

1015. SYNCHRONIZED STROBOSCOPY OF THE SOUND WAVES EMITTED FROM THE HUMAN VOICE ORGANS. R.Timcke.
Naturwissenschaften, Vol. 42, No. 19, 542-3 (1955). In German.

The author describes a study of the living human glottis when singing notes of different frequencies. The observations are made stroboscopically and measurements of the "opening quotient" and "opening time" made for sounds of different loudness. Photographs are shown illustrating the opening in a "polster"-pipe and in the human glottis for a note of frequency 400 c/s. The opening time decreases from 5.3 to 1.5 milliseconds as the frequency increases from 120 to 500 c/s. A.B.Wood

534.791

1016. SOUND LEVEL IDENTIFICATION AND INTERTRIAL STIMULUS VARIATIONS. I.Pollack.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1222-3 (Nov., 1955).

Sound level identification was examined for two restricted ranges of sound levels concurrently. The principal variable was the rate of shifting between the two restricted ranges. In general, identification performance decreases as the rate of shifting between the two ranges increases. However, because of the loss of stimulus information, the arbitrary restriction of the stimulus range results in a lower overall information transmission than without the procedural restriction. An implication for the scaling of elementary aspects of auditory displays is discussed. A.

534.839

1017. A STANDARD (DIN) NOISE METER COVERING THE RANGE 23-123 PHONS. W.Wöhle and E.Salbert.
Nachrichtentechnik, Vol. 5, No. 9, 400-3 (Sept., 1955). In German.

The design specification for the instrument is as follows: (1) calibration in phons, (2) scale ranges of at least 20 phons with 5 phons overlap, (3) equalizing characteristics for the ranges 60-130, 30-60 and below 30 phons, (4) individual noise components to be additive, (5) time of build-up at 1 kc/s to be 200-250 msec with a max. overshoot of 1db, (6) a pressure microphone to be used. The meter, whose design is fully described, is a 7-valve battery-driven instrument with a max. gain of 10^6 and a basic frequency characteristic flat within $\pm$2db between 30 and 8000 c/s. Important design features are (a) the use of a valve-voltmeter indicating meter where measurement of r.m.s. values is achieved by specific choice of charge and discharge time constants and (b) the use of feedback to obtain a linear phon scale. H.G.M.Spratt

OPTICS. RADIATION. SPECTRA 535

535.1

1013. PHOTOELECTRIC MIXING OF INCOHERENT LIGHT. A.T.Forrester, R.A.Gudmundsen and P.O.Johnson.
Phys. Rev., Vol. 99, No. 6, 1691-700 (Sept. 15, 1955).

Beats have been obtained between incoherent light sources by mixing Zeeman components of a visible spectral line at a photosurface. Periodicity in emission was observed through the excitation of a 3 cm cavity. Because of incoherence between the spectral lines and incoherence between the beats from different photocathode areas, the signal-to-shot-noise ratio at the cavity is only 3×10^{-5} but the beats were modulated optically, while maintaining constant total intensity and the receiver was able to yield a signal-to-noise ratio of two at the indicator. The basic idea is that, in the photoelectric process, the emission probability for electrons is proportional to the square of the resultant electric field amplitude, implying an interference between light originating in independent sources. This is a point of view which does not appear to be tested in any other experiment involving quantum effects. The experiment also demonstrates that any time delay between photon absorption and electron release must be significantly less than 10^{-10} second. A.

535.23.08 : 551.521.63

1019. SIMPLE ULTRAVIOLET RADIOMETER. S.C.Stern and C.W.Hill.
Rev. sci. Instrum., Vol. 26, No. 12, 1122-4 (Dec., 1955).

Describes in detail a radiometer for measurement of ultraviolet radiation from sun and sky. As designed, the instrument is selectively responsive to a narrow band of wavelengths and is capable of detecting and measuring low-energy levels. The radiometer consists of a photoelectric sensing element, an ultraviolet transmitting window, and a dry-cell battery mounted in a small housing. Calibration of the instrument shows satisfactory agreement with Lambert's cosine law and a linear relationship between energy flux and output of the phototube. For recording the signal from the radiometer the output is fed to a direct current amplifier which in turn drives a recorder. A typical recording for a cloudy day is presented. A.

535.231.4 : 536.3

1020. TOTAL EMISSIVITIES AND ABSORPTIVITIES OF SOME COMMERCIAL SURFACES AT ROOM AND LIQUID-NITROGEN TEMPERATURES. F.J.Zimmermann.
J. appl. Phys., Vol. 26, No. 12, 1483-8 (Dec., 1955).

The heat transferred by radiation was measured between surfaces at room temperature and liquid-nitrogen temperature. The surfaces used were various combinations of electroplated gold and silver and polished copper sheet. From the test data, the approximate total emissivities of the room-temperature surfaces and the total absorptivities of the liquid-nitrogen surfaces were computed. The results of these tests indicated that electroplated silver surfaces have lower emissivities and absorptivities than equivalently treated electroplated gold surfaces in this temperature range. The best surface tested was a special, bright, unbuffed silver-plated surface. This surface is known to the trade as "silver lume". The room temperature emissivity of this surface was approximately 0.017, and the absorptivity at 77.3°K for radiation from a 300°K surface was about 0.0083. These are the lowest values at these temperatures so far known. It was found that the electroplated surfaces were best used without buffing or any mechanical working of the surface. It is believed that cold working of the metal surface increases its emissivity and absorptivity by increasing its electrical resistivity. A.

535.247.3

1021. MODIFICATION OF TEELE'S METHOD OF HETEROCHROMATIC PHOTOMETRY. B.A.Stevens.
J. Opt. Soc. Amer., Vol. 45, No. 11, 995 (Nov., 1955).

Teele's thermopile and filter photometer (J. Res. Nat. Bur. Stand., Vol. 27, 217-28, Sept., 1941) has been modified by putting the calibrating voltage in opposition to the thermopile voltage, the amplifier and recorder being used as a null indicator. This greatly increases the precision, which is estimated as 0.5% for an illumination of 12 lm/m^2.

J.W.T.Walsh

535.247.4

1022. LINEAR DENSITOMETER CIRCUIT. P.Hariharan and M.S.Bhalla.
Rev. sci. Instrum., Vol. 27, No. 1, 3-5 (Jan., 1956).

A densitometer circuit is described which uses two photomultiplier tubes operated at constant anode current as a balanced range compressor, followed by a logarithmic difference amplifier. A density scale linear to ± 0.01 density unit over a density range of 2.5 is obtained. The circuit is stable, requires no critical adjustments, and is unaffected by changes in the luminous output of the source. A.

535.3 : 548.1

1023. OPTICAL ASYMMETRIES. H.Zocher and C.Török.
Z. Phys., Vol. 142, No. 5, 602-18 (1955). In German.

Various optical phenomena—including Faraday, Doppler, Zeeman and Cotton effects, optical aberration, double refraction and optical rotation—are discussed in relation to the various types of optical asymmetry previously classified (see Abstr. 1490/1955); the possible existence of undiscovered phenomena is discussed. G.F.Lothian

535.315

1024. RESOLVING POWER OF PRISMS MADE FROM HOMOGENEOUS THALLIUM BROMOIODIDE CRYSTALS. A.Smakula.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1086-7 (Dec., 1955).

A good prism has given for D light 70% of the theoretical resolving power. G.F.Lothian

535.317

1025. OPTICAL IMAGERY OF SURFACES AND VOLUMES. R.Stettler.
Optik, Vol. 12, No. 12, 529-43 (1955). In German.

It is shown that it is always possible to form a perfect image, i.e. one free from aberration, of a spherical surface on another spherical surface by the use of a lens of variable refractive index but having rotational symmetry. Aplanatic surfaces and the Luneberg lens are shown to be special cases, and the general forms are derived. R.W.Fish

535.317.25 : 530.162

1026. RESOLVING POWER AND INFORMATION. E.H.Linfoot.
J. Opt. Soc. Amer., Vol. 46, No. 1, 72 (Jan., 1956).

Two criticisms are made of a preceding paper (Abstr. 6882/1955). These are that the number of independent data needed to specify an image is unaffected by aberrations of the system and, secondly, that the equations based upon Huyghens' principle are only approximately true. The concept of "effective number of degrees of freedom" of the image is introduced to overcome the latter difficulty. R.W.Fish

535.317.25 : 530.162

1027. ON RESOLVING POWER AND INFORMATION. G.Toraldo di Francia.
J. Opt. Soc. Amer., Vol. 46, No. 1, 72 (Jan., 1956).

A comment on criticisms by Linfoot (Abstr. 9535/1955). There is general agreement although it is pointed out that Huyghens' principle is not an approximation in all its forms, and that results quoted due to finite pupil size are accurate with mathematical rigour. R.W.Fish

535.327

1028. VARIATION OF REFRACTION OF BENZENE AND SOME BENZENE DERIVATIVES WITH TEMPERATURE. M. Mangenot.
J. Phys. Radium, Vol. 16, No. 7, 60 S – 63 S (July, 1955). In French.

Refractive indices (n) are determined for the wavelengths of Hg and Na lines in the visible for C_6H_6, $C_6H_5CH_3$, $C_6H_5NO_2$ and $C_6H_5NH_2$ for temperatures 20-80° C. $\lambda^2(n^2+2)/(n^2-1)$ plotted against λ^2 gives a straight line whose slope at different temperatures varies directly as the density for a given material. G. F. Lothian

535.33/.34

1029. REPORT ON NOTATION FOR THE SPECTRA OF POLYATOMIC MOLECULES.
J. chem. Phys., Vol. 23, No. 11, 1997-2011 (Nov., 1955).

The report was prepared at the request of the Joint Commission for Spectroscopy of the International Astronomical Union and the International Union of Pure and Applied Physics, and was officially adopted by the Commission at its meeting in Lund in July 1954. The conclusions reached are summarized in a table, while their background, and certain further considerations, are presented in the subsequent text.

535.33

1030. OPTICAL PROBLEMS CONCERNING THE USE OF INTERFERENCE IN THE DETERMINATION OF SPECTROSCOPIC WAVE-NUMBERS. A.V.Pettersson.
Ark. Fys., Vol. 10, Paper 10, 109-12 (1955).

A short discussion of the requirements to be met in photoelectric photometry of spectra in order to avoid distortion of the recorded spectrum by noise from reference lines. A method of achieving this is outlined. D.R.Barber

535.33.03

1031. ON THE ORIGIN OF THE ELECTRONICALLY EXCITED C_2* RADICAL IN HYDROCARBON FLAMES. R.E.Ferguson.
J. chem. Phys., Vol. 23, No. 11, 2085-9 (Nov., 1955).

An isotopic tracer experiment, using carbon 13, has been performed to determine whether the excited C_2 radical in acetylene flames comes directly from the carbon pair of the acetylene burned. In the flame studied, the greater part of the C_2* which radiates does not come from this source, but is produced in some series of reactions in which the $-C\equiv C-$

ond is broken prior to the appearance of C_2*. It is shown urther that most of the C_2* cannot arise from the random reakup of polymers or incipient carbon particles formed by irect polymerization of acetylene. The results appear to avour the choice of a reaction between single-carbon fragments as the predominant source of C_2*. A.

535.33.07

032. SOME OBSERVATIONS REGARDING PHOTOMETRIC EPRODUCIBILITY BETWEEN ULTRAVIOLET SPECTROHOTOMETERS. L.Cahn.
. Opt. Soc. Amer., Vol. 45, No. 11, 953-7 (Nov., 1955).
Several cooperative studies of ultraviolet-visible spectrohotometer photometric accuracy have been published, using ifferent wavelength and absorbance ranges, samples, etc. y analysing the results statistically, it is possible to estimate rror contributed by the various sources, such as sample prepration, wavelength error, 100% line error, and linearity. Reults are reported for a controlled experiment on Beckman DU pectrophotometers, in use under laboratory conditions with perator error controlled, and for a large sample of new DU pectrophotometers with all errors except instrument variations inimized. A.

535.33.07

033. COLLABORATIVE STUDY OF THE PERFORMANCE OF CARY SPECTROPHOTOMETERS. J.M.Vandenbelt and C.H.Spurlock.
. Opt. Soc. Amer., Vol. 45, No. 11, 967-70 (Nov., 1955).
Cooperative measurements were made on standard chromate solutions with thirteen Cary spectrophotometers. bsorbance readings of the instruments were in satisfactory greement, corresponded well with values from earlier studies, nd were proportional to the concentration of standard. A.

535.33.07

034. LUMINOSITY OF SPECTROMETERS. J.W.Perry.
Opt. Soc. Amer., Vol. 45, No. 11, 995-6 (Nov., 1955).
A criticism of recent conclusions drawn by P.Jacquinot bstr. 8588/1955) regarding the relative superiority of grating over prism spectrometers. Comparative data are quoted o show that the prismatic instrument has greater flexibility, eading to several obvious advantages, particularly in the u.v. ange 0.2 to 0.4 micron. D.R.Barber

535.33.07

035. LUMINOSITY OF SPECTROMETERS. P.Jacquinot.
. Opt. Soc. Amer., Vol. 45, No. 11, 996-7 (Nov., 1955).
In reply to the above criticism, it is pointed out that the major differences between the two points of view concern the ctual conditions of use of the grating spectrometer. The atter, if incorporating an optical system designed specially or use with the particular grating employed, may be greatly uperior to a prism instrument when operated under similar onditions. No comparative observations in the u.v. region ere made in the original experiments. D.R.Barber

535.33.07

036. NEW SPECTROMETER SLIT MECHANISM.
I.M.Crosswhite and W.G.Fastie.
. Opt. Soc. Amer., Vol. 46, No. 2, 110-15 (Feb., 1956).
A new type of slit mechanism is described which operates n the principle of the proving ring or loading ring. The load pplied to distort a steel ring is the means by which the slit penings are varied and the opening determined. Very simple evices are described in which straight slit jaws are connected o opposite sides of a flexible ring and known weights are aplied to the ring to obtain the desired slit opening. The mechnism has been used to provide very long dual curved slits for bert type monochromators, in which the proving ring itself cts as one jaw of the curved slits. The dual slits have been ctuated by hydraulic pressure for vacuum operation. A.

535.33.07 : 535.825

1037. INFRARED MICROSPECTROSCOPY. IV. A DOUBLE-BEAM INFRARED MICROSPECTROMETER. E.R.Blout and M.J.Abbate.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1028-30 (Dec., 1955).
For Pt III, see Abstr. 1493 (1953). An attachment is described for converting a double-beam infrared spectrometer into a double-beam infrared microspectrometer quickly and easily. The attachment uses a reflecting microscope system in the sample beam and a gas cell in the reference beam to compensate for the increased path length in the sample beam. Examples of the spectral data obtainable using small crystals and microgram quantities of representative organic chemicals in solution are shown. The results indicate that satisfactory spectral resolution is obtainable in about one-fifth the time necessary for single-beam microspectrometry. A.

535.331/.332

1038. RYDBERG CENTENNIAL CONFERENCE ON ATOMIC SPECTROSCOPY. Edited by B.Edlén.
Lunds Univ. Årsskr. Avd. 2, Vol. 50, No. 21, 1-76 (1955).
The conference was held at Lund, July 1-5 (1954), the programme including 6 review papers and 55 communications covering all main aspects of classical atomic spectroscopy. The review papers, given in full in this report, are: Opening address (W.F.Meggers); Rydberg's discovery of the spectral laws (N.Bohr); Rydberg and the periodic system of the elements (W.Pauli); The influence of spectral series (A.G.Shenstone); and the three papers abstracted below. The other communications, most of which are being published elsewhere, are given as abstracts in this report.

535.331/.332

1039. THE PRESENT STATE AND PROBLEMS OF THE THEORY OF ATOMIC SPECTRA. G.Racah.
Lunds Univ. Årsskr. Avd. 2, Vol. 50, 31-42 (1955). (Rydberg Centennial Conference; see abstract above.)
A review of Slater's method for complex spectra. Examples where p, d and f shells are filling up are discussed. Comparisons with experiment are made. G.E.Brown

535.331/.332 : 539.152.2

1040. NUCLEAR PROPERTIES OBTAINED FROM HIGH RESOLUTION ATOMIC SPECTROSCOPY. H.Kopfermann.
Lunds Univ. Årsskr. Avd. 2, Vol. 50, 43-54 (1955). (Rydberg Centennial Conference; see abstract above.)
Information that can be obtained about nuclear spins, magnetic moments and electric quadrupole moments from optical spectra is discussed. The atomic isotope shifts are surveyed, and some of the anomalies explained. G.E.Brown

535.331/.332

1041. INFRARED ATOMIC SPECTROSCOPY BASED ON USE OF PHOTOCONDUCTIVE DETECTORS. C.J.Humphreys.
Lunds Univ. Årsskr. Avd. 2, Vol. 50, 55-76 (1955).(Rydberg Centennial Conference; see abstract above.)
After a historical survey of means of infrared spectroscopy, photoconductive devices are discussed, especially the lead sulphide cell. Instrumentation and experimental problems are noted and a short survey of the current status of infrared emission spectra is given. G.E.Brown

535.331/.332

1042. ON CERTAIN REGULARITIES IN THE STRUCTURE OF COMPLEX TERM SPECTRA. D. Layzer.
Astrophys. J., Vol. 122, No. 2, 351-3 (Sept., 1955).
Catalan, Rohrlich and Shenstone (Abstr. 4852/1954) have recently discovered certain "astonishing and unexplained regularities" in the term spectra of atoms belonging to the first two long periods. The present note offers a qualitative, theoretical interpretation of these regularities. D. L. Edwards

535.331

1043. A METHOD FOR THE EXPERIMENTAL DETERMINATION OF TRANSITION PROBABILITIES. A.Eberhagen.
Z. Phys., Vol. 143, No. 4, 392-411 (1955). In German.

From a knowledge of basic atomic, and field parameters, and of total intensities of weak lines obtained by photographic photometry of an arc spectrum of the element, the transition probability values are computed for a number of Sr lines in the spectral region, 4000 A to 8000 A. Results for 13 singlet, 39 triplet, and 4 intercombination lines are listed.

D.R.Barber

535.331

1044. HYPERFINE STRUCTURE OF THE SPECTRUM OF RUTHENIUM. III. K.Murakawa.
J. Phys. Soc. Japan, Vol. 10, No. 11, 919-26 (Nov., 1955).

For Pt II, see Abstr. 10028 (1954). The hyperfine structure of the spectrum of Ru I was studied, and it was found that the ratio of the distances of the components due to the even isotopes is given by $\Delta(104 - 102) : \Delta(102 - 100) : \Delta(100-96)/2 = 1 : 1.05 \pm 0.10 : 0.75 \pm 0.15$. There is reason to suppose that the shift $\Delta(98 - 96)$ is anomalously small compared with the shift $\Delta(104 - 102)$ or $\Delta(102 - 100)$. The magnetic moments of the odd isotopes were calculated to be $\mu(Ru^{101}) = -0.69 \pm 0.15$ n.m. and $\mu(Ru^{99}) = -0.63 \pm 0.15$ n.m. A.

535.332 : 539.153.4

OSCILLATOR STRENGTHS FOR TRANSITIONS IN OXYGEN I. See Abstr. 579.

535.333

1045. THE SPECTRUM OF THE Si_2 MOLECULE. A.E.Douglas.
Canad. J. Phys., Vol. 33, No. 12, 801-10 (Dec., 1955).

Two band systems attributed to the Si_2 molecule have been excited in a discharge tube. The first of these is a $^3\Pi$-$^3\Pi$ system of red-shaded bands with heads at 3489, 3556 and 3696 A. The second is an extensive system of $^3\Sigma$-$^3\Sigma$ bands in the visible and near ultraviolet region. High-resolution spectra have been analysed and the rotational and vibrational constants have been determined. A.

535.333

1046. EMISSION AND TWO-BODY RECOMBINATION IN BROMINE. H.B.Palmer.
J. chem. Phys., Vol. 23, No. 12, 2449 (Dec., 1955).

The continuous emission in the visible region from bromine vapour heated to temperatures between 1400 and 2250° K by shock waves arises almost entirely from 2-body atom recombinations. R.F.Barrow

535.333

1047. INFRARED SPECTRUM OF LiH. W.Klemperer.
J. chem. Phys., Vol. 23, No. 12, 2452 (Dec., 1955).

Lines of the 1, 0 and 2, 1 bands have been observed in emission. The dissociation energy is estimated to be $D_0(LiH)$ equal to or greater than 56 kcal. R.F.Barrow

535.338.334

1048. EMISSION SPECTROSCOPY AT LIQUID HELIUM TEMPERATURE. J.G.Hirschberg.
Phys. Rev., Vol. 99, No. 6, 1898-9 (Sept. 15, 1955).

Photoelectric recording with a grating and etalon gave good resolution of the structure of the 4686 A He line, showing that the Doppler broadening was sensibly reduced from that observed with liquid air cooling. G.F.Lothian

535.34

1049. INFRARED INTENSITIES IN LIQUID AND GAS PHASES. S.R.Polo and M.K.Wilson.

It is shown that Debye's and Onsager's theories of dielectric polarization lead to the same expression for the relation between the intensities of an infrared absorption band in the liquid and in the gas phases. A

535.34

1050. CONVENIENT TECHNIQUE FOR OBTAINING THE ULTRAVIOLET AND VISIBLE SPECTRA OF PURE LIQUIDS. B.M.Mitzner.
J. Opt. Soc. Amer., Vol. 45, No. 11, 997-8 (Nov., 1955).

Normal NaCl cells for infrared of thickness down to 0.025 cm may be used. It is found that the 250 millimicron bands of pure liquid C_6H_6 are displaced about 2 millimicrons from those for a solution in iso-octane. G.F.Lothian

535.34

1051. INSTRUMENTATION IN THE FAR INFRARED. C.Haeusler.
J. Phys. Radium, Vol. 16, No. 11, 882-8 (Nov., 1955). In French.

A review of components of spectrographs for the far i.r., such as light sources, filters, dispersive systems, detectors, etc. The common mountings are described and the results obtained with them are discussed. 51 references are given.

R.W.Fish

535.34

1052. MILLIMETER AND SUBMILLIMETER WAVE SPECTROSCOPY. C.A.Burrus and W.Gordy.
Phys. Rev., Vol. 101, No. 2, 599-602 (Jan. 15, 1956).

Rotational lines of several linear molecules have been measured with high precision in the region of 0.8 to 2.00 mm wavelength. The energy source for this region was a silicon crystal multiplier driven by a centimetre-wave klystron. A silicon crystal was also used as the detector. An evacuated bolometer detector was developed for the 3 mm wave region and was used to detect rotational lines down to 2.0 mm. Although its sensitivity is lower than that of the crystal detector, the bolometer will be useful for absolute power measurements in the shorter millimetre region. A.

535.34.07

1053. SOME DEVICES FOR THE STARK MODULATION MILLIMETER-WAVE SPECTROGRAPH. A.Okaya.
Rev. sci. Instrum., Vol. 26, No. 11, 1024-8 (Nov., 1955).

High sensitivity and wide-band frequency characteristic for a microwave spectrograph are required for the detection of weak absorption lines and for researches on the hyperfine structures of the spectral lines of free molecules in the millimetre wave range. In order to improve the important components of the spectrograph, the author has designed a low-loss K-band Stark cell, a frequency multiplier of wide-band frequency character, a Wheatstone bridge-type triode lock-in detector and a compact square-wave generator. The overall sensitivity of the spectrograph using these elements was about 5×10^{-8} cm^{-1} in the 6 mm wave range. This made it possible to detect new spectral lines of CH_2O and observe their new magnetic hyperfine structures. A.

535.343

1054. EXCITON ABSORPTION IN CUPROUS OXIDE. J.H.Apfel and L.N.Hadley.
Phys. Rev., Vol. 100, No. 6, 1689-91 (Dec. 15, 1955).

The exciton absorption spectrum of Cu_2O has been measured at low temperatures. As reported by Gross, the observed lines fit a hydrogen-like series formula. The wavelength shift of the position of the optical absorption band edge has also been measured as a function of temperature. The dependence is approximately quadratic. A.

535.343 : 539.11

1055. BROADENING OF IMPURITY LEVELS IN SILICON. M.Lax and E.Burstein.
Phys. Rev., Vol. 100, No. 2, 592-602 (Oct. 15, 1955).

Sharp absorption lines have been observed in p- and n-type silicon whose absolute and relative positions lead to

their interpretation as optical transitions between bound states of trapped holes or electrons that are approximately hydrogenic in character. These lines have a finite breadth of the order of 0.001 eV at liquid helium temperatures. This breadth is determined by the zero-point vibrations of the lattice. At higher temperatures, the squared breadth increases in proportion to the mean squared amplitude of oscillation of those lattice modes that contribute significantly to the broadening. The theory indicates that the modes of importance have wavelengths of the order of the Bohr radius of the trapped carrier state. These are rather long wavelength acoustic modes whose energy h ω corresponds to 80°K. Thus the squared broadening is expected to increase by a factor of two from helium to nitrogen temperatures — and this increase is confirmed experimentally. This confirms the hypothesis that the broadening is due to the interaction of the trapped electron with the acoustic lattice vibrations. The form of the electron-lattice interaction is taken to be that of the Bardeen–Shockley deformation potential, and its strength is determined from the experimental mobility. Thus the theory contains no adjustable parameters. In absolute magnitude, the theoretical line breadth turns out to be several times too large. Possible reasons for the discrepancy are discussed. A.

535.343

1056. BrF BANDS IN THE SCHUMANN REGION. P.H.Brodersen and S.Mayo.
Z. Phys., Vol. 143, No. 4, 477-8 (1955). In German.

A number of red-degraded bands have been observed in a hollow-cathode discharge in BrF_3 vapour: they lie between 57 000 and 64 100 cm^{-1}. Vibrational analyses are suggested and the electronic states are briefly discussed. R.F.Barrow

535.343

1057. CELLS FOR THE STUDY OF ABSORPTION SPECTRA OF LIQUEFIED GASES OR LIQUIDS AS A FUNCTION OF PRESSURE AND TEMPERATURE. TESTS WITH LIQUID BENZENE. B.Oksengorn and B.Vodar.
J. Phys. Radium, Vol. 16, No. 11, 893-4 (Nov., 1955). In French.

Describes the construction of a cell of thickness adjustable by spacers between 1 micron and 2 mm, for pressures (p) up to 1500 kg/cm^2 and for temperatures −90° to +150°C. It is found that the middle ultraviolet bands of benzene show a red shift proportional to p^2. G.F.Lothian

535.343

1058. SPECTROSCOPIC STUDIES OF SOME AROMATIC ACIDS WITH A HETEROATOM IN THE SIDE-CHAIN. A.I.Kiss and B.R.Muth.
J. chem. Phys., Vol. 23, No. 11, 2187-9 (Nov., 1955).

Absorption spectra of substituted benzenes in the u.v. were measured and are tabulated. C.Turner

535.343

1059. SPECTROSCOPIC STUDIES OF AROMATIC SULFIDES AND SELENIDES. A.I.Kiss and B.R.Muth.
J. chem. Phys., Vol. 23, No. 11, 2189 (Nov., 1955).

The u.v. absorption spectra of diphenyl sulphide and substitutes were measured and are tabulated. Extinction is increased by changing the number of heteroatoms. C.Turner

535.343

1060. NOTE ON THE ABSORPTION SPECTRA OF THE METHYL RADICAL. J.Higuchi.
J. chem. Phys., Vol. 23, No. 11, 2197-8 (Nov., 1955).

The orbital energies of the free radical are calculated; the spectrum must be at wavelengths less than 2100 A and will be difficult to observe. G.F.Lothian

535.343 : 539.132

1061. THE SPECTRUM AND DISSOCIATION ENERGY OF BrF. P.H.Brodersen and J.E.Sicre.
Z. Phys., Vol. 141, No. 5, 515-24 (1955). In German.

A re-investigation of the absorption spectrum has revealed a new system A1 - $X^1\Sigma^+$, and shows that the levels in the upper state $B0^+$ are strongly perturbed. The new value for the dissociation limit of 0^+ is 22 915 cm^{-1} and corresponds to dissociation into $Br(^2P_{1/2}) + F(^2P_{3/2})$. State 1 correlates with $Br(^2P_{3/2}) + F(^2P_{3/2})$. Constants ($cm^{-1}$) are as follows:

State	ν_e	ω_e	$x_e\omega_e$	$y_e\omega_e$
B 0^+	18 281.2	377.6	4.711	−0.101
A 1	17 385	378	16	
$X^1\Sigma^+$	0	672.6	4.5	

D''_0 = 19 230 cm^{-1} or 2.384 eV. R.F.Barrow

535.343

1062. ABSORPTION SPECTRUM AND QUANTUM STATES OF THE PRASEODYMIUM ION. I. SINGLE CRYSTALS OF PRASEODYMIUM CHLORIDE. E.V.Sayre, K.M.Sancier and S.Freed.
J. chem. Phys., Vol. 23, No. 11, 2060-5 (Nov., 1955).

The structure of the polarization spectra exhibited by single crystals of anhydrous praseodymium chloride permitted the assignment of quantum states of the praseodymium ion because of the fact that the symmetry of the crystal fields had previously been determined by X-rays. The crystals which were diluted with isomorphic, colourless lanthanum chloride, were grown from metals. Observations of transitions over the range from 2200 A to 18 000 A at the temperatures of liquid nitrogen and liquid helium led to the identification of seven upper states as well as the substates into which they were split by the crystal fields. The four lowest substates of the ground state also were characterized. The F triplet was found to be inverted. All the transitions were forced electric dipole in nature. A.

535.343

1063. ABSORPTION SPECTRUM AND QUANTUM STATES OF THE PRASEODYMIUM ION. II. ANHYDROUS PRASEODYMIUM FLUORIDE IN FILMS. J. chem. Phys., Vol. 23, No. 11, 2066-8 (Nov., 1955).

The absorption spectra of anhydrous fluoride were examined to confirm term designations derived from the spectra of anhydrous praseodymium chloride. In the fluoride, praseodymium ion is at the centre of a micro-field of C_{2v} symmetry and in the chloride it is in a field of C_{3h} symmetry. There was complete consistency in the interpretations of the spectra of the two compounds. A new phenomenon appeared in the spectrum of the fluoride, however. The selection rules prohibiting some of the possible transitions of an ion in a field of C_{2v} symmetry valid at the temperature of liquid nitrogen were lifted at the temperature of liquid helium, where in fact all possible transitions occurred. There is evidence against any gross crystallographic transformation. It is surmised that the positions of energy minimum for the ions lie slightly off the symmetric positions, possibly due to higher-order interactions such as occurs in the case of barium titanate. A.

535.343 : 535.372

1064. EXCITED STATES OF THE NAPHTHALENE MOLECULE. II. FURTHER STUDIES ON THE FIRST SINGLET-SINGLET TRANSITION. D.S.McClure.
J. chem. Phys., Vol. 24, No. 1, 1-12 (Jan., 1956).

The polarized fluorescence and absorption spectra of naphthalene and naphthalene d-8 have been studied under the conditions described in Pt I (Abstr. 180/1955) for the absorption of ordinary naphthalene. When all the data are examined and compared with the Raman assignments, a complete set of totally symmetric fundamentals for the first excited state can be found. The b_{1g}-modes which bring about the short-axis absorption of naphthalene may be combinations rather than fundamentals. The short-axis fluorescence shows that b_{1g}-combinations rather than fundamentals bring about vibrational-electronic interaction, yet most of the short-axis fluorescence has a_g-origins. This latter fact is not completely understood,

although partial explanations are offered. It is deduced from the vibrational pattern of the absorption and emission spectra that a change in length of the central link and a slight expansion of the rings are the most important geometry changes occurring in the transition to the first excited state. The symmetry in this state remains D_{2h}. A.

535.343

1065. EXCITED TRIPLET STATES OF POLYATOMIC MOLECULES. II. FLASH-LAMP STUDIES ON AROMATIC KETONES. D.S.McClure and P.L.Hanst.
J. chem. Phys., Vol. 23, No. 10, 1772-7 (Oct., 1955).

The apparatus used for observing triplet-triplet transitions in polyatomic molecules was the same as in Pt I (Abstr. 6119/1951) except that resonance lamps were replaced by a flash lamp. Triplet-triplet spectra are reported for benzophenone, acetophenone, β -bromo and β -iodo naphthalene. No triplet-triplet absorption was found in benzene, biacetyl, acetone dibromo benzene, or diisopropyl ketone. Detailed studies of the energy levels of benzophenone and acetophenone are reported. A.

535.343

1066. NOTES ON THE ABSORPTION OF CARBON TETRACHLORIDE IN THE 12 MICRON REGION. J.Lecomte.
J. Phys. Radium, Vol. 16, No. 10, 815-16 (Oct., 1955). In French.

Four lines in the vapour spectrum at 763–780 cm^{-1} are attributed to the combination $\nu_1 + \nu_4$ for the four principal isotopic forms. The relative intensities of these lines are in the proportion of the isotopic concentrations; but their positions are significantly different from calculated values. Absorptions for solutions in CS_2 and for thin liquid films are also given. G.F.Lothian

535.343

1067. INFRARED SPECTRUM OF PLUTONIUM HEXAFLUORIDE. N.J.Hawkins, H.C.Mattraw and W.W.Sabol.
J. chem. Phys., Vol. 23, No. 11, 2191-2 (Nov., 1955).

The fundamental vibration frequencies are listed and used to calculate the vibrational contributions to specific heat, entropy and free energy. G.F.Lothian

535.343

1068. INFRARED SPECTRA OF NpF_6 AND PuF_6. J.G.Malm, B.Weinstock and H.Claassen.
J. chem. Phys., Vol. 23, No. 11, 2192-3 (Nov., 1955).

The fundamental vibration frequencies are tabulated. It is considered that the moleculas have the symmetry of point group O_h. G.F.Lothian

535.343

1069. INFRARED SPECTRUM OF $Ni(CO)_4$ VAPOR. L.H.Jones.
J. chem. Phys., Vol. 23, No. 12, 2448 (Dec., 1955).

New measurements make it necessary to modify some assignments previously published. G.F.Lothian

535.343 : 541.183

1070. INFRARED SPECTRUM OF AMMONIA ADSORBED ON POROUS SILICA GLASS. D.J.C.Yates, N.Sheppard and C.L.Angell.
J. chem. Phys., Vol. 23, No. 10, 1980-1 (Oct., 1955).

A broad maximum at 2900 cm^{-1} suggests hydrogen bonding between the NH_3 and the glass. G.F.Lothian

535.343

1071. ABSORPTION BANDS OF CCl_4 IN THE FAR INFRARED REGION. H.Yoshinaga.
J. chem. Phys., Vol. 23, No. 11, 2206 (Nov., 1955).

New measurements of liquid CCl_4-bands from 660 to 100 cm^{-1} are shown in absorption curves for 3 thicknesses of cell and a table of maxima with their assignments is given. These agree with Raman data. C.Turner

535.343 : 539.133

1072. INFRARED SPECTRA AND STRUCTURE OF THE CRYSTALLINE SODIUM ACETATE COMPLEXES OF U(VI), Np(VI), Pu(VI) AND Am(VI). A COMPARISON OF METAL–OXYGEN BOND DISTANCE AND BOND FORCE CONSTANT IN THIS SERIES. L.H.Jones.
J. chem. Phys., Vol. 23, No. 11, 2105-7 (Nov., 1955).

Infrared spectra of solid $NaXO_2(ac.)_3$ with X = U, Np, Pu and Am, have been observed. From the symmetric and asymmetric stretching frequencies of the O–X–O groups, approximate X–O force constants have been calculated and were found to decrease in the order given, the respective values being about 0.705, 0.698, 0.675 and 0.612 megadyne/cm. From the cell constants for $NaXO_2(ac.)_3$ it is apparent that the X–O bond distance decreases in the same order. Thus, a decrease in bond distance appears to be accompanied by a decrease in force constant, probably because the bond, though shortened by contraction of the electron shells of the metal, is weakened by interaction with the extra valence shell electrons. A.

535.343

1073. ENVELOPES OF SOME ABSORPTION BANDS OF GASEOUS COMPOUNDS BETWEEN 20 AND 40 : TRICHLORFLUOROMETHANE, ACETONE AND CARBON DISULPHIDE. A. Hadni.
Ann. Phys. (Paris), Vol. 10, 874-82 (Sept.-Oct., 1955). In French.

The ν_3 band of $CFCl_3$ at 535 cm^{-1} has 3 peaks in the Q branch attributed to the 3 major isotopic constituents; from their separation (about 2 cm^{-1}) the form of the vibration is calculated. The band contours for acetone are compared with the forms calculated from the theory of Badger and Zumwalt; it is concluded that 484 cm^{-1} is the symmetrical vibration δ_{CCC} and that 527 and 380 cm^{-1} are probably CO deformations. CS_2 shows numerous bands in the region 384–415 cm^{-1} which are in course of analysis. G.F.Lothian

535.343

1074. INFRARED ABSORPTION SPECTRUM OF N-DIMETHYLAMINODIBORANE BETWEEN 15 AND 40 MICRONS. J.E.Stewart.
J. chem. Phys., Vol. 23, No. 11, 2204-5 (Nov., 1955).

Measurements with a CsBr prism. A table of frequencies is given from 640 to 250 cm^{-1}, with their assignments. C.Turner

535.343 : 535.375.5

1075. INFRARED AND RAMAN SPECTRA OF FLUORINATED ETHYLENES. VI. FLUOROTRICHLOROETHYLENE. J.R.Nielsen, C.W.Gullikson and A.H.Woollett.
J. chem. Phys., Vol. 23, No. 11, 1994-6 (Nov., 1955).

The infrared spectrum of gaseous CCl_2:CClF was observed from 2 to 22 microns with NaCl and KBr prisms. The Raman spectrum of the liquid was photographed with a three-prism glass spectrograph of linear dispersion 15 A/mm at 4358 A, and the depolarization ratios of the stronger Raman bands measured. All but one of the fundamental vibration frequencies have been assigned, and the spectra interpreted in detail. A.

535.343 : 535.375.5

1076. INFRARED AND RAMAN SPECTRA OF DICYANOACETYLENE. II. F.A.Miller, R.B.Hannan, Jr and L.R.Cousins.
J. chem. Phys., Vol. 23, No. 11, 2127-9 (Nov., 1955).

For previous part, see Abstr. 2352 (1953). The infrared spectrum has been extended downward to 320 K, and one more combination tone located. Fifteen Raman frequencies have now been observed in place of the four reported earlier, allowing extension and revision of the vibrational assignments. All but one of the fundamentals have now been observed directly, and that one (107 K) is well established from combination

tones. The totally symmetric fundamentals have been reassigned to 2290, 2119 and 692 K. A.

535.343 : 535.375.5

1077. INFRARED AND RAMAN SPECTRA OF 1,1,2,2-TETRACHLOROETHANE; CALCULATION OF NORMAL VIBRATIONS. K.Naito, I.Nakagawa, K.Kuratani, I.Ichishima and S.Mizushima. J. chem. Phys., Vol. 23, No. 10, 1907-10 (Oct., 1955).

Infrared spectra have been measured in the gaseous, liquid, and solid states and in solutions. Raman spectra have been observed in the liquid and solid states. From the experimental results the equilibrium molecular forms of the rotational isomers have been determined. The normal vibrations of the molecule in the trans and gauche forms have been calculated as an 8-body problem, and the assignment of the observed infrared and Raman frequencies in all the states of aggregation has been made. A.

535.343 : 539.133

1078. INFRARED SPECTRUM AND MOLECULAR STRUCTURE OF SUCCINONITRILE. G.J.Janz and W.E.Fitzgerald. J. chem. Phys., Vol. 23, No. 10, 1973-4 (Oct., 1955).

The vibrational spectrum is given for liquid at $+60^{\circ}$ C and for solid at -45° C. It is deduced that the latter exists in the gauche form only. G.F.Lothian

535.343 : 541.57

1079. NATURE OF THE HYDROGEN BOND. II. THE EFFECT OF HYDROGEN BONDING AND OTHER SOLUTE-SOLVENT INTERACTIONS UPON THE SHAPE AND INTENSITY OF THE INFRARED OH BAND OF PHENOL. H.Tsubomura. J. chem. Phys., Vol. 23, No. 11, 2130-3 (Nov., 1955).

For Pt I, see Bulletin of the Chemical Society of Japan, Vol. 27, 445 (1954). The hydrogen-bonded OH bands of phenol were studied in ternary systems, each of which being composed of phenol, a proton acceptor, and a solvent. The acceptors used were ethyl ether, ethyl acetate, acetonitrile and hexamethylene tetramine. It was confirmed that the frequency, shape, and molecular extinction coefficient of the band are not changed by the concentration of the acceptor, as far as the latter is smaller than about 2 mole/litre. The spectra were slightly modified by further increase of the concentration of the acceptor. These modifications were in all cases far smaller than the modification due to the hydrogen bonding, and the peak intensities remained nearly constant. The equilibrium constants for the formation of the hydrogen bond were determined for all acceptors and the heat of formation was determined for the case of hexamethylene tetramine. It was found that the decrease of frequencies of the hydrogen-bonded OH bands was not strictly parallel to the increase of equilibrium constants. A.

535.343 : 548.0

1080. MOTIONS OF MOLECULES IN CONDENSED SYSTEMS. X. INFRARED ABSORPTION ANISOTROPY AND INDUCED MOLECULAR MOTION IN A SINGLE CRYSTAL OF BENZENE. J.Zwerdling and R.S.Halford. J. chem. Phys., Vol. 23, No. 12, 2221-8 (Dec., 1955).

For Pt VIII, see Abstr. 197 (1951). Infrared absorption spectra were observed with radiation polarized linearly along each of the two extinction axes contained in a thin cross-section from a single crystal of benzene grown especially for this purpose. The spectra indicate consistently that the cross-section was the 010 plane, that they record separately the absorptions polarized along the a-axis and the c-axis respectively. The anisotropies of the induced absorptions exhibited by five fundamental molecular vibrations (ones that appear only in spectra for condensed phases) are all quite similar and may even be identical. It thus appears that the induced motions, superimposed upon the several intrinsic ones by the perturbing intermolecular interactions, have a property of similarity independent of the differing natures of the intrinsic motions that are being perturbed. A.

535.343

1081. MICROWAVE ABSORPTION IN COMPRESSED OXYGEN. A.A.Maryott and G.Birnbaum. Phys. Rev., Vol. 99, No. 6, 1886 (Sept. 15, 1955).

Microwave absorption in O_2 above 1 atm at 0.0765, 0.302 and 0.778 cm^{-1} indicates that there is a zero frequency term $\tan\delta/p = 2.91 \times 10^{-7}$ atm^{-1} (theoretical 2.87×10^{-7}), and $\Delta\nu/p = 0.0175$ cm^{-1} atm^{-1}. The resonant contribution has average high pressure values of $\Delta\nu/p = 0.025$ cm^{-1} atm^{-1} and $\nu = 0.5$ cm^{-1} compared with the low pressure values 0.05 cm^{-1} atm^{-1} and 2.0 cm^{-1} respectively. D.H.Whiffen

535.343

1082. NEW METHOD FOR THE OBSERVATION OF HYPERFINE STRUCTURE OF NH_3 IN A "MASER" OSCILLATOR. K.Shimoda and T.C.Wang. Rev. sci. Instrum., Vol. 26, No. 12, 1148-9 (Dec., 1955).

Weak hyperfine satellites have been observed with very large signal-to-noise ratios when microwave power at frequencies corresponding to these satellites is introduced into a "maser" which is oscillating at the frequency of the main inversion line of NH_3. The satellite transitions are accompanied by a reduction of the amplitude of oscillation at the main-line frequency. A composite oscilloscope trace showing the structure of the weakest of the four quadrupole satellites associated with the 3-3 inversion line of $N^{14}H_3$ is presented. A.

535.343 : 537.228.1

1083. VIBRATIONAL ABSORPTION SPECTRA IN THE RADIOFREQUENCY REGION OF SOME NATURAL PIEZOELECTRIC SOLIDS. J.Duchesne and J.Monfils. C.R.Acad. Sci. (Paris), Vol. 241, No. 12, 749-50 (Sept. 19, 1955). In French.

The temperature coefficients, $(-1/\nu) \times (d\nu/dT)$, of absorption frequencies near 30 Mc/s are tabulated for Rochelle salt, quartz and some ribonucleic acid derivatives from 77-294° K. The values for the nucleic acids are −10 to $+42 \times 10^{-6}$. D.H.Whiffen

535.343

1084. MICROWAVE SPECTRUM OF IMINE-DEUTERATED ETHYLENIMINE. T.E.Turner, V.C.Fiora and W.M.Kendrick. J. chem. Phys., Vol. 23, No. 10, 1966 (Oct., 1955).

The pure rotational spectrum of C_2H_4ND was analysed, frequency and transition assignments were made, and the structure determined. For C_2H_4ND, an oblate symmetrical top, a-axis selection rules apply whereas b-axis ones hold for C_2H_4NH. The six structural parameters calculated will be very slightly affected by zero-point vibrations. J.Jacobs

535.343 : 539.132

1085. MICROWAVE SPECTRUM OF PROPIOLACTONE. N.Kwak, J.W.Simmons and J.H.Goldstein. J. chem. Phys., Vol. 23, No. 12, 2450 (Dec., 1955).

Eight low-J transitions for this strained four-membered ring have been measured in the region 18-34 kMc/s, and agree well with calculations using the rigid rotor approximation. The moments of inertia agree well with those obtained by electron diffraction. J.Hawgood

535.343 : 539.133

1086. MICROWAVE SPECTRUM AND PLANARITY OF FORMAMIDE. R.J.Kurland. J. chem. Phys., Vol. 23, No. 11, 2202-3 (Nov., 1955).

The spectrum suggests planarity in accord with Pauling's resonance representation. Quadrupole hyperfine structure was observed for the more intense lines, and rotational constants were computed from 4 transitions. J.Jacobs

535.345

1087. ULTRAVIOLET ABSORPTION OF ATOMIC NITROGEN IN ITS IONIZATION CONTINUUM. A.W.Ehler and G.L.Weissler.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1035-43 (Dec.,1955).

A method has been developed to measure absolute absorption coefficients of atomic nitrogen in the region of its ionization continuum below 800 A. This was achieved by passing radiation from an appropriate light source through the plasma of a Philips Ionization Gauge (P.I.G.) type of discharge into a normal-incidence vacuum spectrograph. Light intensities at various wavelengths between 400 A and 800 A were recorded on film and measured photometrically for the cases of the absorbing plasma either on or off. By taking into account information on the concentration of ions in such discharges, and by considering the relative probabilities of formation of other plasma constituents from their appearance potentials by electron impact methods, it was possible to estimate the concentration of atomic nitrogen in the plasma and to show that apart from neutral N_2 atomic nitrogen was the sole cause of the attenuation of light. The experimental absorption cross-sections were found to agree well with the theoretical values of Bates and Seaton. In order to support some of the assumptions used, separate experiments were performed in which the light-source pulse was passed through the plasma region after the P.I.G. discharge had been extinguished. It could be shown that the ions had been swept out and that excited and metastable states had also disappeared. Thus, the only remaining plasma component was atomic nitrogen, and its absorption cross-sections were within the error limits the same as the first investigation. A.

535.345

1088. SAMPLING TECHNIQUE FOR TRANSMISSION MEASUREMENTS IN THE FAR INFRARED REGION. H.Yoshinaga and R.A.Oetjen.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1085 (Dec., 1955).

Powders may be suspended in paraffin or in a polyethylene film. Absorption curves are reported for ZnS measured in these media to 200 microns. G.F.Lothian

535.345

1089. COLOR CENTERS IN ALKALI-SILICATE GLASSES CONTAINING ALKALINE EARTH IONS. R.Yokota.
Phys. Rev., Vol. 101, No. 2, 522-5 (Jan. 15, 1956).

Samples of alkali metal oxide–silica glasses with various kinds and amounts of alkaline earth oxide calcium oxide and silica were prepared, X-irradiated, and studied by spectrophotometry. Bleaching experiments with visible light were carried out. No effect of alkaline earth content upon the absorption spectra was detected. Room temperature bleaching of a K_2O - SrO - SiO_2 glass with light of wavelength corresponding to the X-ray induced absorption band at 1.95 eV, decreased absorption generally but failed to create a new absorption band such as the Z_1 band found in KCl, containing $SrCl_2$, that has been irradiated and then bleached. Comparisons are made with alkali-halide systems containing alkaline earth halides. It is suggested that there are inadequacies in the quasi-crystalline model of glass when applied to these glasses. A.

535.345 : 530.162 : 771.5

1090. THE MEASURE OF "NOISE" IN OPTICS. B.Picinbono and M.Savelli.
Optica Acta, Vol. 2, No. 2, 106-7 (July, 1955). In French.

The concept of "noise" has been carried over from electronics into optical theory. A method of measuring the noise of a photographic emulsion is described. An image of a point source is projected on to the emulsion and the transmitted light falls on to a photomultiplier tube. The output, as the film is pulled past the image, is fed into a harmonic analyser. The interpretation of the results and sample frequency curves are discussed. R.W.Fish

535.345 : 530.162 : 771.5

1091. THE OPTICAL DETERMINATION OF PHOTOGRAPHIC "NOISE". P.Croce and M.Marquet.
Optica Acta, Vol. 2, No. 2, 107-8 (July, 1955). In French.

The "noise" of a photographic emulsion is obtained by carrying out harmonic analysis optically. The emulsion is used to form a diffraction pattern whose intensity distribution is recorded photographically or by photomultiplier tube. The distribution may be related to the frequency spectrum of the noise. The method is shown to given equivalent results to other methods. R.W.Fish

535.345 : 539.11

1092. OPTICAL PROPERTIES OF METALS. V.L.Ginzburg and G.P.Motulevich.
Uspekhi fiz. Nauk, Vol. 55, No. 4, 469-535 (1955). In Russian.

A well-documented survey article, (the first of the authors is the leading Soviet theoretical physicist). On the theoretical side topics covered include, in addition to the classical material, such matters as micro-theory in the cases of normal and abnormal skin effects, effect in i.r. region of spectrum, estimation of quantum effects. Methods of measuring n_{eff}, χ_{eff}, A are dealt with, and there is a discussion of experimental data. 64 refs. C.R.S.Manders

535.371

1093. THE LOW-TEMPERATURE LUMINESCENCE OF SILVER BROMIDE WITH ADDITION OF SILVER SULPHIDE. K.R.Dorfner.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 331-60 (1955). In German.

A study of the yellow luminescence (5800 A) of silver bromide due to 0.02 mol % inclusion of Ag_2S. Crystals are of three kinds, cold-worked, annealed and those "formed" by cycling the crystal between irradiation at low temperatures and warming to room temperature. Study of afterglow and thermoluminescence reveals two groups of traps with estimated energies of 0.21 and 0.27 eV respectively. Theoretical models are discussed for the luminescence processes which depend on both electron and ionic migration. G.F.J.Garlick

535.371

1094. ON ELECTRON TRAPPING STATES OF VERY SMALL ENERGY DEPTH IN ZINC SULPHIDE. N.Riehl and H.Ortmann.
Z. Naturforsch., Vol. 10a, No. 11, 896-7 (1955). In German.

535.371

1095. THE INFLUENCE OF CRYSTAL STRUCTURE ON THE LUMINESCENCE OF CALCIUM SILICATE (Mn, Pb). H.Lange and G.Kressin.
Z. Phys., Vol. 142, No. 4, 380-6 (1955). In German.

Calcium silicate, when in its low-temperature form (Wollastonite structure) shows an orange emission. The high-temperature form (pseudo Wollastonite structure) shows a green emission under cathode rays. In mixed form manganese is taken up by the Wollastonite form and produces a shift of the emission to the red region. G.F.J.Garlick

535.371

1096. PHOTOLUMINESCENT MODULATION IN NONUNIFORMLY EXCITED ZnS PHOSPHORS. R.E.Halsted.
Phys. Rev., Vol. 99, No. 6, 1897 (Sept. 15, 1955).

A ZnS phosphor layer excited by ultraviolet light within its lattice absorption has its emission modulated by an applied electric field due to movement of carriers in and out of the excited surface region. The phase of the modulation indicates unambiguously the sign of the more mobile carrier. From the observations made electron:hole mobilities appear to be in the ratio of 1000 : 1. G.F.J.Garlick

535.371

1097. ON THE SPECTRAL DISTRIBUTION OF INFRARED-STIMULATED PHOSPHORESCENCE OF Pb ACTIVATED ZnS TYPE PHOSPHORS. S.Asano.
J. Phys. Soc. Japan, Vol. 10, No. 10, 903-5 (Oct.); Erratum, No. 11, 1027 (Nov., 1955).

535.371

1098. PHOSPHORESCENCE OF SOLIDS CONTAINING THE MANGANOUS OR FERRIC IONS. L.E.Orgel.
J. chem. Phys., Vol. 23, No. 10, 1958 (Oct., 1955).

535.371

1099. QUENCHING OF BIACETYL FLUORESCENCE IN SOLUTION. H.L.J.Bäckström and K.Sandros.
J. chem. Phys., Vol. 23, No. 11, 2197 (Nov., 1955).

The effect of various quenchers on the relatively long-lived fluorescence was measured. The lifetime decreased with quencher concentration. Quenching is assumed to be due to a chemical reaction between the photo-formed biradical and the quencher molecule. G.F.J.Garlick

535.371

1100. LUMINESCENCE QUENCHING BY OXYGEN: CYCLOHEXANE-BENZENE-P-TERPHENYL. P.J.Berry and M.Burton.
J. chem. Phys., Vol. 23, No. 10, 1969-70 (Oct., 1955).

535.371

1101. CADMIUM SULFIDE WITH SILVER ACTIVATOR. J.Lambe.
Phys. Rev., Vol. 100, No. 6, 1586-8 (Dec. 15, 1955).

Further experimental evidence is presented in connection with a model which has been proposed by Lambe and Klick for CdS(Ag). In this model it is assumed that the silver activator gives rise to a level which is approximately 0.4 eV below the conduction band, and that luminescence occurs when an electron in such an activator level recombines with a free hole. It is shown that irradiation in the 1 micron infrared region stimulates luminescence by generating free holes, while also causing well known quenching effects in photocurrent. It is also shown that 3 micron irradiation gives rise to photoconduction by exciting electrons from the activator levels into the conduction band. The proposed model indicates that irradiation in the 3 micron region should quench luminescence by removing electrons from activator levels, and this is found experimentally. These experiments further substantiate the proposed model for CdS(Ag). A.

535.371 : 535.33.03

1102. FLUORESCENCE AND AVERAGE LIFETIME OF EXCITED OH($^2\Sigma^+$) IN FLAMES. H.P.Broida and T.Carrington.
J. chem. Phys., Vol. 23, No. 11, 2202 (Nov., 1955).

It is shown by measurement of fluorescence yield of OH in an oxyacetylene flame excited by a water vapour–argon discharge that the lifetime of the excited state of the OH is 6×10^{-10} sec and not 6×10^{-7} sec as previously assumed. Thus one kinetic collision can remove the electronic energy and persistence of initial rotational distribution through 10^3 collisions need not be assumed. G.F.J.Garlick

535.371 : 548.7

1103. CHANGE OF LUMINESCENT SCREEN PROPERTIES UNDER ELECTRON IRRADIATION IN CATHODE-RAY TUBES K.H.J.Rottgardt and W.Berthold.
Z. Naturforsch., Vol. 10a, No. 9-10, 736-40 (1955). In German.

The deterioration of luminesence efficiency of ZnS phosphors under cathode-ray bombardment depends on crystal lattice structure and is little influenced by the nature and amount of activator impurities or by cathode-ray energy. G.F.J.Garlick

535.371 : 621.385.832

1104. PHOSPHORS FOR TRICOLOUR TELEVISION TUBES. A.Bril and H.A.Klasens.
Philips Res. Rep., Vol. 10, No. 5, 305-18 (Oct., 1955).

The efficiencies and spectral distributions were measured of various blue, green and red phosphors which might be considered for use as primaries in tricolour tubes. It is shown that the choice of the red phosphor mainly determines the luminous properties of the screen and that a compromise has to be found between colour reproduction and light output. Of the known red phosphors, a silver-activated zinc-cadmium sulphide and a copper-activated zinc-cadmium selenide can be expected to produce higher efficiencies for near-white colours than is possible with the commonly used manganese-activated zinc phosphate. A.

535.372

1105. ON THE LUMINESCENCE OF NaCl–Ag. P.Dobrinski and H.Hinrichs.
Z. Naturforsch., Vol. 10a, No. 8, 620-30 (Aug., 1955). In German.

The luminescence spectrum has bands at 2500 A and 4000 A. Phosphorescence after X-ray irradiation and glow curves from 150° C to 300° C are studied. The glow curves show ten different peaks some dependent on silver content. Stimulation of emission occurs for F-band irradiation. G.F.J.Garlick

535.372

1106. FLUORESCENCE EXCITATION SPECTRUM OF ANTHRACENE. G.T.Wright.
Phys. Rev., Vol. 100, No. 2, 587-8 (Oct. 15, 1955).

Surface escape of fluorescence is enhanced in crystals which strongly re-absorb their own fluorescence. This is investigated quantitatively for anthracene. The apparent fluorescence efficiency, measured by viewing the intensity of fluorescence transmitted through the crystal, is found to decrease as the depth of penetration of the excitant decreases. For photoexcitation this produces a fluorescence excitation spectrum since different exciting wavelengths penetrate different distances. The minima of the excitation spectrum correspond to absorption maxima. The maxima of the first absorption band of the crystal are hence found to occur at wavelengths 3960, 3740, 3540, 3370 and 3220 A. A.

535.372 : 535.376

1107. SCINTILLATION RESPONSE OF ANTHRACENE CRYSTALS TO SHORT RANGE ELECTRONS. G.T.Wright.
Phys. Rev., Vol. 100, No. 2, 588-90 (Oct. 15, 1955).

There is a significant difference between the response to electrons incident on the crystal surface and to electrons liberated inside the crystal. Possible explanations for this difference are discussed. The "primary" photon cascade theory proposed by Birks is considered unacceptable particularly in view of recent measurements of the shapes of scintillation pulses. Surface escape of fluorescence, proposed by the author, (see preceeding abstract) is discussed quantitatively using the fluorescence excitation spectrum of anthracene and is considered adequate to explain the observed difference in the scintillation response curves. A.

535.372 : 535.343

1108. FLUORESCENCE AND ABSORPTION SPECTRUM OF 1,8-DIMETHYLNAPHTHALENE. H.C.Wolf.
Z.Naturforsch., Vol. 10a, No. 9-10, 800-1 (1955). In German.

Wave-numbers of maxima and intensities are tabulated for 27 000-31 000 cm^{-1}; the results are compared with those for other dimethylnaphthalenes given in Abstr. 5339 (1955). G.F.Lothian

535.375.5

1109. CALCULATION OF DEPOLARIZATION FACTORS

OF THE RAMAN LINES OF CCl_3X MOLECULES. A.Weber and S.M.Ferigle.
J. chem. Phys., Vol. 23, No. 12, 2207-9 (Dec., 1955).

The depolarization factors of the totally symmetric vibrations of CCl_3H, CCl_3D and CCl_3Br are computed using previously derived expressions for the spur and anisotropy of the polarizability tensor. The associated normal coordinate treatment uses the Wilson FG-matrix technique with a general quadratic potential function. Calculated and observed depolarization factors agree well for stretching but not for the bending modes. A.

535.375.5 : 548.7

1110. VIBRATION SPECTRUM OF PIEZOELECTRIC CRYSTALS. V. SULPHATE OF LITHIUM AND OF POTASSIUM. J.P.Mathieu, L.Couture and H.Poulet.
J. Phys. Radium, Vol. 16, No. 10, 781-5 (Oct., 1955). In French.

For Pt IV, see Abstr. 4733 (1953). The results of measurement of the Raman and infrared absorption spectra are given. Variations in the frequency and in the intensity of certain lines in the spectra with the orientation of the monocrystal are discussed and interpreted. G.I.W.Llewelyn

535.375.55

1111. RAMAN SPECTRA OF HYDROGEN PEROXIDE IN CONDENSED PHASES. I. THE SPECTRA OF THE PURE LIQUID AND ITS AQUEOUS SOLUTIONS. R.C.Taylor and P.C.Cross.
J. chem. Phys., Vol. 24, No. 1, 41-4 (Jan., 1956).

The Raman spectrum of liquid 99.5% H_2O_2 has been obtained at 30° and −40° C and compared with the spectrum of 90% D_2O_2 at −40° C. Three bands not previously reported were observed and their assignment, together with that of the remaining bands, is discussed. Raman spectra were also obtained for aqueous solutions at 30° and −40° C over the complete concentration range. The interpretation is qualitatively in agreement with the results of other work which indicate that the addition of hydrogen peroxide to water results in more extensive hydrogen bonding and an increased degree of order in the solutions. A.

535.376/.377

1112. THERMOLUMINESCENCE MEASUREMENTS ON ELECTROLUMINESCENT ZnS:Mn FILMS. R.E.Freund.
Phys. Rev., Vol. 100, No. 2, 760-1 (Oct. 15, 1955).

Electroluminescence excitation gave a three-peak glow curve with trap depths of 0.37, 0.41 and 0.43 eV. Film resistivities were of the order of 10^{18} ohm.cm.
G.F.J.Garlick

535.376

1113. EDGE ELECTROLUMINESCENCE FROM ZnS SINGLE CRYSTALS. R.W.Smith.
Phys. Rev., Vol. 100, No. 2, 760 (Oct. 15, 1955).

Electroluminescence emission is observed in the lattice absorption region of ZnS as well as in the visible region. It is suggested that both electrons and holes are injected into the crystals giving the edge emission by band to band recombination. G.F.J.Garlick

535.376

1114. ELECTROLUMINESCENCE OF ZINC SULFIDE SINGLE CRYSTALS. D.R.Frankl.
Phys. Rev., Vol. 100, No. 4, 1105-11 (Nov. 15, 1955).

Quantitative measurements of the electroluminescent emission from synthetic single crystals of zinc sulphide with silver paint contacts under 60 c/s half-wave voltage excitation have been carried out at several temperatures. Other workers have shown that the emission intensity has two major peaks per cycle, the first coincident with the voltage maximum and the second as the voltage is falling to zero. These peaks have the same colour, and both appear to originate throughout the crystals, but they have different voltage dependencies. The second peak is the larger at low voltage amplitudes, but the first peak grows the more rapidly with increasing voltage amplitude. Emission intensities of the order of 10^{12} photons per second, with energy efficiency of the order of 10^{-8}, were obtained. The total current consists of a displacement current which is linear with voltage and a conduction current which is roughly exponential with voltage. No evidence of space-charge polarization was detected. It is tentatively suggested that excitation occurs by impact of conduction electrons accelerated through internal barriers, that the two emission peaks result, respectively, from immediate recombination and from recombination delayed by trapping of the excited electron, and that the electric field tends to hold the electron in the trap state. A.

535.377

1115. THERMOLUMINESCENCE OF ZINC SULFIDE PHOSPHORS DOUBLY ACTIVATED WITH COPPER AND MANGANESE. S.Shionoya.
J. chem. Phys., Vol. 23, No. 10, 1976-7 (Oct., 1955).

Glow curves of ZnS—Cu—Mn phosphors are explained by deep traps due to Cu (0.21 and 0.23 eV) and a shallow trap due to Mn (0.15 eV). G.F.J.Garlick

535.377

1116. THERMOLUMINESCENCE INDUCED BY PRESSURE AND BY CRYSTALLIZATION. E.J.Zeller, J.L.Wray and F.Daniels.
J. chem. Phys., Vol. 23, No. 11, 2187 (Nov., 1955).

Freshly precipitated calcium carbonate shows thermoluminescence without initial excitation. Crystals subjected to high pressures show much greater emission. Age of mineral limestones etc. can be assessed by the different behaviour of radiation and of pressure induced thermoluminescence.
G.F.J.Garlick

535 377

1117. THERMOLUMINESCENCE OF SOME AROMATIC HYDROCARBONS. J.Sharma.
J. chem. Phys., Vol. 24, No. 1, 39-40 (Jan., 1956).

The thermoluminescence of diphenyl, solid benzene, toluene, and p-xylene has been studied after exciting them with cathode rays at liquid oxygen temperature. Also the decay rates of the afterglow have been measured. The thermoluminescence in each case consists of several peaks emitted at low temperature. The afterglow decay has been found to be exponential. A

535.39

1118. MIRROR COATINGS FOR LOW VISIBLE AND HIGH INFRARED REFLECTANCE. G.Hass, H.H.Schroeder and A.F.Turner.
J. Opt. Soc. Amer., Vol. 46, No. 1, 31-5 (Jan., 1956).

The effect of single and multilayer coatings on the reflectance of metals is discussed. Two multilayer film designs especially suitable for producing mirror coatings with low visible and high infrared reflectance are described. In the first design aluminium is coated with evaporated films of germanium and silicon monoxide, each film approximately one-quarter wavelength thick. In one example using this construction the visible reflectance is decreased to 2% and a steep rise in reflectance from 5% to 90% takes place from 0.7 to 1.2 μ. In a second more versatile construction aluminium is coated with two dielectric layers separated by a semi-transparent metal film. In one example of this design, consisting of Al-SiO-Al-SiO, the low-reflectance region extends from 0.4 to 1.5 μ and more than 90% reflectance is obtained for all wavelengths longer than 3 μ. These filter mirrors are useful for decreasing unwanted visible radiation in infrared equipment. A.

535.39

1119. ON THE SHEEN GLOSS. H.Hasunuma and J.Nara.
J. Phys. Soc. Japan, Vol. 11, No. 1, 69-75 (Jan., 1956).

Experiments of sheen gloss of metals and theoretical explanation of them are given. Sheen gloss is related with the specularly reflected light which appears by an incident angle above a critical angle θ_c. θ_c is connected with the r.m.s. roughness h as: $2h \cos \theta_c = \lambda/k$, where k is of the order of 2 or 3. This formula is explained by a theory similar to the Kirchhoff's diffraction theory, treating the roughness as a stationary random function given by the Ornstein-Uhlenbeck process. Scattered light is separated to R- and D-comp. The former corresponds to sheen and its brightness is given as a function of incident angle. D-comp. is the part that represents scattered light. A.

535.39

1120. "COMPENSATED OPAL" WORKING STANDARD EQUIVALENT TO MAGNESIUM OXIDE. F.W.Billmeyer, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 1, 72-3 (Jan., 1956).

The preparation of magnesium oxide reflectance standards is laborious and the use of opal glass with a compensating system has been proposed. A compensator is described which has errors less than 0.6% between 450 and 700 micron. Some practical details are given. R.W.Fish

535.39 : 523.4

1121. A TENTATIVE EXPLANATION OF THE NEGATIVE POLARIZATION IN DIFFUSE REFLECTION. Y.Öhman.
Stockholms Obs. Ann., Vol. 18, No. 8, 10 pp. (1955).

The negative polarization for small phase angles of light from the planets is explained as an effect of repeated reflection in pairs of small cleavage surfaces forming an angle of 90^0 or thereabout. R.W.Fish

535.393 : 539.11

1122. INTERPRETATION OF THE OPTICAL PROPERTIES OF METAL SURFACES. S.Roberts.
Phys. Rev., Vol. 100, No. 6, 1667-71 (Dec. 15, 1955).

The surface optical properties of the metals Ag, Au, Cu, Pt, Ir and Ni in the infrared are shown to obey a simple generalized form of the Drude formula for the free electron theory, but involving two types of free electrons. If the surface optical constants are not anomalous, this procedure may be interpreted as a source of information on the density and relaxation times of free electrons in different overlapping energy bands. The evidence for and against anomalous surface optical constants is reviewed and it is concluded that the optical constants in the interior are the same as those measured on the surface. A.

535.4 : 536.461

1123. PHASE CONTRAST OBSERVATIONS OF FLAMES. M.J.Saunders and A.G.Smith.
J. appl. Phys., Vol. 27, No. 2, 115-17 (Feb., 1956).

The phase contrast principle has been applied to a telescopic system to produce a simple instrument of high sensitivity for studying inhomogeneities in fluid media. As an example of the power of the method, the phase contrast telescope has been used to study the regions in and around premixed propane gas flames. A.

535.41

1124. A SIMPLE PROPERTY OF DIELECTRIC MULTILAYER THIN FILMS. P.Giacomo.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 867-9 (Oct. 3, 1955). In French.

By the suppression of successive half-wavelength layers the system of layers, whether identical or not, of thickness $p\lambda/4$ can be reduced to simpler systems of which the transmission can be easily computed for the wavelength λ. The application of this simple relation to the Fabry-Perot interferometer is briefly discussed. S.Tolansky

535.412

1125. ABBE'S EXPERIMENT AS A MEANS OF MEASURING ABSOLUTE LIGHT PHASE. A.Lohmann.
Z. Phys., Vol. 143, No. 5, 533-7 (1956). In German.

Phase differences have been measured by means of the interference pattern formed by a double or triple slit. Abbe's experiment replaces the double slit by the +1 and −1 orders of a spectrum from a grating. The phase difference of a plate placed over one order displaces the fringes. This arrangement has the advantage that the fringe position is independent of wavelength. R.W.Fish

535.412

1126. AN IMAGE-FORMING SYSTEM OF HIGH LIGHT GRASP FOR THE MEASUREMENT OF ABSOLUTE PHASE DIFFERENCES, AND ITS USE IN THE DETERMINATION OF THE OPTICAL CONSTANTS OF K IN THE U.V. SPECTRAL REGION. H.J.Bolle.
Z. Phys., Vol. 143, No. 5, 538-47 (1956). In German.

The triple-slit interference fringes can be used to determine phase differences. The new method uses the +1, 0 and −1 order diffraction images formed by a grating in place of the slits. The phase differences and amplitude changes introduced by reflection at an evaporated potassium surface allow the optical constants to be calculated. The theory of the method is given with practical details and sample records. R.W.Fish

535.417

1127. AN INTERFEROMETER FOR MEASURING THE SPATIAL FREQUENCY RESPONSE OF A LENS SYSTEM. L.R.Baker.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 871-80 (Nov., 1955).

The new approach to optical image formation from the standpoint of Fourier methods has led to the need for characterizing a lens by its response to spatial frequencies. Methods of measuring this response by means of photometric image scanning are neither simple nor accurate, especially when the object is illuminated with partially coherent light, whereas the instrument described here gives the frequency response directly and for any specified conditions of illumination. The apparatus is an interferometric photometer consisting basically of a shearing interferometer giving any amount of shear but with no tilt. It is shown that under certain conditions the total light flux in the sheared interferogram is a measure of the frequency response of the lens producing it. Some experimental results are compared with those obtained theoretically by Hopkins for the case of a defocused optical system. A.

535.417

1128. VACUUM INTERFEROMETER AND CADMIUM OVEN. K.B.Adams and K.Burns.
J. Opt. Soc. Amer., Vol. 46, No. 1, 36-8 (Jan., 1956).

Temperature and pressure changes during observation by means of a Fabry—Perot interferometer are discussed. A temperature regulated vacuum chamber has been designed to minimize the effects of these changes. Details of a simple and efficient interferometer and housing are given. A convenient and satisfactory oven for holding a Michelson lamp at any desired temperature between that of the room to the standard 315^0 C is described in detail. The vacuum interferometer, the lamp house, and the assembly used to compare the spectra of Hg^{198} and Cd^{114} are illustrated. A.

535.417

1129. FABRY—PEROT INTERFEROMETER WITH FINITE APERTURES. K.L.Vander Sluis and J.R.McNally, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 1, 39-46 (Jan., 1956).

Closed mathematical expressions are developed for the Fabry—Perot interferometer with finite apertures for both noncoherent and coherent illumination. For most practical cases these expressions are substantially equivalent but reveal

more serious aperture effects than the approximate theoretical treatment of Geiger. The effects expected are of particular importance in problems involving either compound interferometers or high reflection coatings. However, even at low reflectivities significant reductions in peak intensity and resolution are to be expected. The conditions for obtaining a 99% efficient interferometer are expressed in terms of the reflectivity and aperture parameters. These expressions still limited by the assumptions of smooth, plane parallel films, suggest modifications to the usual applications of the interferometer.

A.

535.417 : 531.715.1

1130. OBLIQUITY CORRECTION CURVES FOR USE IN LENGTH INTERFEROMETRY. C.F.Bruce.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1084-5 (Dec., 1955).

In Fizeau-type interferometers the aperture is often placed slightly off-centre in order to view the returning light. The effect of the size of the apertures and their positions can introduce fringe displacement effects which are computed. The fringe displacement computed is wavelength dependent. Correction curves are presented which enable a rapid application of the correction to be made in precision interferometry. The fringe displacement is computed as a function of the phase difference between the centre and the edge of the aperture. Computations are made for a maximum path difference of 800 mm which might be attainable with isotope mercury and krypton sources. The results found are given in the form of curves.

S.Tolansky

535.417 : 531.717.81

1131. CONTROL AND INTERFEROMETRIC MEASUREMENT OF PLATE FLATNESS. P.D.Carman.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1009-10 (Dec., 1955).

For two flatness requirements involved in the testing of air survey cameras special techniques have been devised. Photographic plates used for camera calibration should be flat to one or two microns. To achieve this the ¼-in. plate glass supporting the emulsion is bent flat and held flat during exposure. Flatness is determined in an interferometer using infrared light. Camera register glass flatness is also checked interferometrically. Since counts of over 100 fringes are required, two monochromatic light sources are used, chosen to produce regular arrangements of black and coloured fringes which permit counting by groups.

A.

535.417 : 535.31

1132. AN INTERFERENCE OPTICAL ALINEMENT METHOD. G.A.Harle and B.S.Thornton.
Nature (London), Vol. 176, 651-52 (Oct. 1, 1955).

A system is described which is applicable to the alignment of coaxial optical systems with a large number of surfaces. A spatial distribution of non-localized interference fringes is employed. Thus, the necessity of image location is eliminated and a technique combining the advantages of aperture sight and image alignment is available. Various interferometric arrangements are described. One uses a bi-prism and slit. Another uses a point source and the Michelson interferometer with mirrors parallel. A third uses a Fabry-Perot etalon and multiple-beam fringes are employed of the non-localized type described by Tolansky. The theory of the methods are similar to those of the image alignment method.

S.Tolansky

535.417 : 539.211

1133. MULTIPLE-BEAM FRINGES OF EQUAL CHROMATIC ORDER. VI. METHOD OF MEASURING ROUGHNESS. W.F.Koehler and W.C.White.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1011-14 (Dec., 1955).

For Pt III, see Abstr. 356 (1954). A new method of measuring the roughness of a polished glass surface is reported. Fringes of various orders, n, are formed at the same wavelength. The measured half-width is plotted as a function of 2/n. The slope S of the best straight line through the experimental points is used to obtain a roughness value from an independently determined, experimental function S v. h(r.m.s.). The term h(r.m.s.) is the root-mean-square height of the irregularities on the equivalent surface. When this experimental function is extrapolated to h(r.m.s.) = 0 the corresponding value of S is compatible with a value estimated from theory for the case of super-smooth surfaces.

A.

535.417 : 539.211

1134. MULTIPLE-BEAM FRINGES OF EQUAL CHROMATIC ORDER. VII. MECHANISM OF POLISHING GLASS. W.F.Koehler.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1015-20 (Dec., 1955).

The following additional information concerning the polishing mechanism has been obtained with multiple-beam fringes of equal chromatic order: (1) a more efficient and reliable technique for measuring the average cutting rate during one minute of polishing; (2) the history of a single particle planing glass; and (3) quantitative data obtained when polishing glass with a polyethylene lap, barnesite, and water.

A.

535.42 : 538.566

1135. ON THE THEORY OF WAVE PROPAGATION IN INHOMOGENEOUS MEDIA. W.R.MacLean.
Z. Phys., Vol. 143, No. 3, 331-9 (1955). In German.

A mathematical treatment of wave diffraction using a simple approximation to Green's function, which differs from the exact function by neglecting reflected waves. The use of the approximation for very short wavelengths leads to formulae applicable in the optical case.

J.J.Phipps

535.434

1136. RAYLEIGH'S RATIO (ABSOLUTE TURBIDITY LEVELS) FOR BENZENE AND CARBON TETRACHLORIDE. II. CORRECTIONS. R.F.Stamm and P.A.Button.
J. chem. Phys., Vol. 23, No. 12, 2456-7 (Dec., 1955).

Results previously published (Abstr. 7614/1953) on values of Rayleigh's ratio (R_{90}) determined by the photographic method were erroneous due to an incorrect experimental technique.

G.I.W.Llewelyn

535.434

1137. EXCLUDED VOLUME EFFECT ON LIGHT SCATTERING OF THE COILED LINEAR MACROMOLECULE. A.Peterlin.
J. chem. Phys., Vol. 23, No. 12, 2464-5 (Dec., 1955).

The smaller density of larger molecules due to the excluded volume effect leads to an expression for the correction of molecular end to end distances (R) determined by light scattering. This amounts to 10% for polymethylmethacrylate solutions, giving better agreement with other methods of determining R.

G.F.Lothian

535.434 : 537.531.85 : 539.166.74

1138. STOKES' VECTOR-PARAMETER. G.V.Rozenberg.
Uspekhi fiz. Nauk, Vol. 56, No. 1, 77-110 (1955). In Russian

Ten aspects of the topic are discussed whilst two applications of vector-parameter description are developed with some fulness, namely Compton scattering and transfer of radiation in turbid media. 31 refs.

C.R.S.Manders

535.514

1139. NEW ARRANGEMENT OF AgCl POLARIZER FOR THE INFRARED. A.S.Makas and W.A.Shurcliff.
J. Opt. Soc. Amer., Vol. 45, No. 11, 998-9 (Nov., 1955).

Two sets of symmetrically opposed plates avoid displacement of the beam.

G.F.Lothian

535.515

1140. OPTICAL METHOD FOR DETERMINING THE SMALL PHASE RETARDATION WITH WHITE LIGHT. I.Tsurumi.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1021-3 (Dec., 1955).

With a white light source, in an optical arrangement in which two kinds of birefringent plates are put between crossed Nicols, the phase retardation caused in the system changes in proportion to $\delta \times \sin 2\theta$, in which δ and θ mean retardation smaller than about 70 mμ and the rotating angle of the second birefringent plate, respectively. A.

535.557

1141. CONSTRUCTION OF A FLOW BIREFRINGENCE APPARATUS WITH EXTERIOR ROTOR: APPLICATION TO THE STUDY OF THE POLYDISPERSITY OF A SOLUTION OF TOBACCO MOSAIC VIRUS. J.Leray.
J. Chim. phys., Vol. 52, No. 10, 755-64 (Oct., 1955). In French.

A description is given of a concentric-cylinder type of flow cell in which the outer cylinder rotates at speeds from 10 to 3000 r.p.m. with about 1% variation. The gaps between the cylinders can be made 0.3, 0.6 and 0.95 mm respectively, with an average radius of about 25 mm. A thermostatted cooling system is provided. The optical arrangement is the same as that used by Sadron (J. Phys. Radium, Vol. 7, No. 6, 265, 1936) with an optical path of the order of 10 cm. The effect of turbulence is discussed with particular reference made to the curves given by Jerrard (Abstr. 112/1951) and the work of Wayland (Abstr. 5909/1955). The effect of the nature of the walls on the polarization state of the reflected light is considered. Curves showing the variation of the angle of extinction and birefringence with velocity gradient are given for tobacco mosaic virus (T.M.V.) and the results discussed. It is found that if the lengths of the T.M.V. particles, as found by the electron microscope, are multiplied by 1.4 they agree with those found here, namely 3780 A. H.G.Jerrard

535.557

1142. VARIATION OF FLOW BIREFRINGENCE WITH STRESS. A.S.Lodge.
Nature (London), Vol. 176, 838-9 (Oct. 29, 1955).

The complete description of birefringence and stress may be effected by use of optic and stress ellipsoids. Assuming these to have the same orientation it is possible to compare the differences of their principal axes. The ratio of the differences should have simple properties. Using data on moderately concentrated polymer solutions, it is found that for a wide range the ratio is independent of shear rate, polymer concentration and distribution of chain length. This is in agreement with an earlier theory (Lodge, A.S. Proceedings of the Second International Congress Rheology, 229, Butterworth 1954) which attributes stress and birefringence to a network deformation. An equation for the ratio is given: this can also be obtained from the theory of Kuhn and Kuhn (Helvetica Chimica Acta, Vol. 28, 1533, 1945; Vol. 29, 71, 1946) for very dilute polymer solutions. H.G.Jerrard

535.557 : 532.133

1143. APPARATUS FOR THE SIMULTANEOUS STUDY OF STREAMING DOUBLE REFRACTION AND VISCOSITY. H.G.Jerrard.
Rev. sci. Instrum., Vol. 26, No. 11, 1007-17 (Nov., 1955).

Many liquids, which are normally isotropic, become double refracting when subjected to shearing stresses produced by a velocity gradient established within them. A detailed description is given of a concentric cylinder apparatus in which velocity gradients of the order of 4000 $\pi \sec^{-1}$ have so far been produced. Higher values are possible. The annular gap between the cylinders varies from about 0.3 mm to 0.8 mm and has an average radius of about 25 mm. The outer cylinder can rotate at speeds up to 2500 r.p.m. or more: these are accurately determined by an electronic tachometer. The inner cylinder can be rigidly clamped or allowed to move subject to restriction by a beryllium copper torsion wire. In the latter case the viscous drag due to the moving liquid can be measured, as in a Couette viscometer, and hence values for the viscosity coefficient found simultaneously with measurements of double refraction. A cooling system, controlled by thermostats, is provided to maintain the liquid at a constant temperature; this is recorded by a thermocouple embedded in the inner cylinder. The optical system is described with brief details of the methods for the determination of the extinction directions in the liquid and the magnitude of the double refraction. The latter is measured by a sensitive quarter-wave plate compensator with a half-shadow device The accuracy of the instrument is fully discussed. A.

535.568.1

1144. A PHOTOELECTRIC POLARIMETER WITH VIBRATING HALF-WAVE PLATE. J.Bouchard and J.Moret-Bailly.
C.R. Acad. Sci. (Paris), Vol. 241, No. 22, 1562-3 (Nov. 28, 1955). In French.

A Laurent half-wave plate is combined with a photocell to make a sensitive detector for use with a polarimeter. The detector consists of a half-wave plate, oscillating about an axis perpendicular to its plane, in front of an analyser. Behind the latter is the photocell consisting of nine photomultipliers. The detector is very sensitive to luminous flux changes and results are said to be better than with visual methods. H.G.Jerrard

535.64

1145. APPARATUS FOR THE AUTOMATIC MEASUREMENT OF THE WOLTER COLOUR DISPARITY NUMBER. H.W.Bodmann.
Ann. Phys. (Leipzig), Vol. 17, No. 1, 28-41 (1955). In German.

The formula proposed by H.Wolter (given in Abstr. 2344/1954) for expressing the difference between the spectral distributions of two illuminants from the point of view of colour rendering can be determined experimentally by means of a double spectrophotometer described by the author. The whole spectrum is scanned 10 times per sec and the difference between the intensities of the two sources at each wavelength is measured by means of a differential photocell and, after amplification, is squared and integrated by means of a thermoelement. Measurements on several fluorescent lamps gave a disparity from daylight of about 0.25, the corresponding figure for sunlight being of the order of 0.1. J.W.T.Walsh

535.64

1146. ADVANCED COLOR GEOMETRY. H. von Schelling.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1072-9 (Dec., 1955).

It is assumed that surfaces of equal brightness are ellipsoids in the (X,Y,Z) colour-space, that the centres of all of those ellipsoids are at the origin, and that one ellipse, which lies in the plane Y = 0, is common to all ellipsoids. This special set of surfaces of the second degree is used for defining a non-Euclidean distance, a measure of the distance between two colours. Theoretical sensitivity ellipses are found in the chromaticity diagram if this measure is applied to infinitesimal distances. The result is compared with MacAdam's well-known sensitivity ellipses. Distances between white and spectral colours are discussed and compared with observed numbers of just perceptible steps. Finally, a theoretical hue discrimination curve is computed for equal brightness and compared with average observations. An excellent agreement above 495 millimicrons is marred by a complete failure below this wavelength. Here the assumption of equal brightness breaks down. A.

535.653

1147. MULTIVARIATE NORMALITY OF THE COLOR-MATCHING PROCESS. W.R.J.Brown, W.G.Howe, J.E.Jackson and R.H.Morris.

J. Opt. Soc. Amer., Vol. 46, No. 1, 46-9 (Jan., 1956).

A sample of 656 colour matches made on a binocular wide-field colorimeter was studied for normality by the chi-square test. The observing conditions were typical of those used in colour-discrimination experiments. Observing sessions of thirty observations each were considered individually. In addition, a nonlinear instrument drift was removed from the data within each observing session. Following these precautions, the trivariate colour matches were studied, a single variate at a time. Chi-square values were computed by dividing the data into cells of equal expected frequency. The distribution in terms of the instrument primaries was found to be normal. The data were individually transformed by the principal axis transformation and the chi-square values were again computed. The distributions were again found to be normal. The normality of the univariate distributions in the two coordinate systems is taken as strong evidence of the trivariate normality of the distribution of colour matches. A.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84.

535.89 :771.44

1148. NEW FLASH ILLUMINATION UNIT. Á.Bardócz and Á.Klátsmanyi.

Rev. sci. Instrum., Vol. 26, No. 10, 945-7 (Oct., 1955).

A new type of flash illumination unit for use with flash tubes, electric sparks, and exploding wires is described. The system is controlled by a thyratron tube in a manner different from up to now in that the controlled energy does not pass through the thyratron tube. The basic circuit of the apparatus consists of two flash tubes or spark gaps connected in series. The flash tubes or spark gaps are ignited by giving double voltage first to the one and, when it is ignited, to the other spark gap or flash tube by means of the thyratron tube. The flash tube illumination circuit makes the simultaneous operation of more than two flash tubes or sparks possible. The thyratron tube igniting the illumination unit may be controlled by electric or by mechanical means. A.

HEAT 536

536.25

1149. THE INFLUENCE OF THE INTERFACE METAL/GAS ON THE CONVECTION FROM FINE WIRES. I.Epelboin and A.Vapaille.

C.R.Acad. Sci. (Paris), Vol. 241, No. 5, 463-5 (Aug. 1, 1955). In French.

The coefficients of thermal exchange have been determined by two different methods for wires of Ni, Pt and Ag in air and hydrogen. The two methods give results in agreement within the experimental error and confirm that the coefficients depend upon the nature of the interface. The results are displayed as graphs of the Nusselt number against the product of Grashof and Prandtl numbers. F.E.Hoare

536.33 : 537.31

1150. ELECTRICAL FLUCTUATIONS AND HEAT RADIATION. S.M.Rytov.

Uspekhi fiz. Nauk, Vol. 55, No. 3, 299-314 (1955). In Russian.

A descriptive historical account of the topic, drawing attention at all stages to the fecundity of Mandel'shtam's contributions. C.R.S.Manders

536.4.031 : 541.15

1151. RADIO-CARBON CONTENT AND DELAYED BOILING OF LIQUIDS. C.Dodd.

Proc. Phys. Soc. B, Vol. 68, Pt 9, 686-9 (Sept., 1955).

An investigation on the influence of radioactive sources on the time delay occurring before a superheated liquid boils. With the help of a 3 cm^3 bubble chamber filled alternatively with diethyl-ether and pentane (no mention whether normal- or iso-pentane) it has been found that: (a) ionization from external sources reduces the delay time; (b) owing to the presence of C^{14}, normal diethyl-ether has a delay time shorter than diethyl-ether free from C^{14}. Numerical values of the dependence of delay time on ionization and temperature are given. G.Martelli

536.413.2

1152. THERMO-BIMETALS. W.Rienäcker.

Schweiz. Arch. angew. Wiss. Tech., Vol. 21. No. 9, 289-95 (Sept., 1955). In German.

Details are given for the manufacture of bimetals consisting of two thin sheets which possess dissimilar expansion coefficients but similar moduli of elasticity, and which are united together under high pressures and at high temperatures with exclusion of air. These bimetals bend according to temperature alteration, and a method for calculating changes of curvature is given. Data for 8 pairs of suitable metals for use at high or low temperatures are included, viz: Ni-Mn-Fe (20/6/74), Fe; Ni; Ni-Fe (36/64); Ni-Mn-Fe (20/6/74), Ni-Fe (36/64); Ni-Mn-Fe (20/6/74), Ni-Fe (42/58); Ni-Mn-Fe (20/6/74), Ni-Fe (46/54); Mn-Ni-Cu, Ni-Fe (36/64); Ni-Mn-F with intermediate layer, Ni-Fe (36/64); Ni-Mn-Fe with Cu-overlayer, Ni-Fe (36/64). Thermal treatment for elimination of internal tension and thermo-bimetals of high, medium, and low electrical resistance but with the same or almost equal incurvation are described. The use of bimetals for circuit breakers where direct heating is due to passage of current is discussed, and a paragraph on corrosion stability is included. There are 10 references, 4 diagrams, and a table of data. H.H.Hodgson

536.42

1153. ON DENSITY FLUCTUATIONS IN SOLIDS AND LIQUIDS. G.Borelius and A.Sandin.

Ark. Fys., Vol. 10, Paper 17, 187-96 (1955)

On the basis of the idea (Abstr. 1239/1954) that fusion can be interpreted as part of a structural transition caused by density fluctuations in the crystal lattice, simple relations are derived connecting the volume changes due to thermal dilatation, fusion and compression. The formulae are in reasonable agreement with experimental results on a number of metals. E.H.Sondheimer

536.421

1154. ELECTROMAGNETIC SUSPENSION OF A MOLTEN ZONE. W.G.Pfann and D.W.Hagelbarger.

J. appl. Phys., Vol. 27, No. 1, 12-18 (Jan., 1956).

A new method of suspending a molten zone is as follows: clamp a horizontal cylindrical ingot at both ends; apply a horizontal magnetic field normal to the ingot where the zone is to be suspended; and pass a direct current through the ingot, creating an upward force equal and opposite to the gravitational force, thereby permitting the zone to be melted and suspended. It is shown theoretically that such a zone will be stable in a uniform magnetic field if its length-to-diameter ratio is less than π and if its length is less than $0.17(\gamma/\rho)^{\frac{1}{2}}$, where γ and ρ denote surface tension and density, respectively, in c.g.s. units. Some experimental results and practical considerations are discussed. A

536.421 : 536.71

1155. THE SOLID–LIQUID EQUILIBRIUM DIAGRAM OF ARGON AND KRYPTON. R. Heastie.

Nature (London), Vol. 176, 747-8 (Oct. 15, 1955).

The equilibrium diagram has been investigated previously by thermal analysis. The method is not satisfactory, as the melting point for any composition and the freezing point

for near equimolecular mixtures cannot be well located. Now the vapour pressure of twenty-two different mixtures has been measured as a function of the temperature and graphs of log p against 1/T enable the transition points to be determined. The components are found to be soluble in all proportions in the solid and liquid states. Measurements extend to 62°K for argon-rich mixtures and 70°K for krypton-rich mixtures; no evidence of phase change was found. The equilibrium diagram is shown. F.E.Hoare

536.421.1 : 539.217

1156. MELTING OF SOLIDS. T.H.K.Barron.
Nature (London). Vol. 177, 23 (Jan. 7, 1956).
Brief report of a symposium on melting, diffusion and related topics held at Ottawa in Oct. 1955.

536.421.4

1157. THE EFFECT OF GROWTH CONDITIONS UPON THE SOLIDIFICATION OF A BINARY ALLOY. W.A.Tiller and J.W.Rutter.
Canad. J. Phys., Vol. 34, No. 1, 96-121 (Jan., 1956).
This investigation provides both a theoretical and an experimental analysis of the factors which affect the mode of solidification of a binary alloy. These factors are: (i) the concentration of solute in the melt (C_0); (ii) the rate of solidification (R); (iii) the temperature gradient in the melt at the solid-liquid interface (G). Extremely high purity lead was produced by zone refining and, from this material, crystals containing known concentrations of tin, silver and gold were grown under a range of well-controlled growth conditions. The mode of solidification was investigated by a careful study of the change in appearance of the solid-liquid interface with a change in growth conditions. For a crystal containing a specific C_0 of solute it was observed that (a) the transition from a smooth interface to a cellular interface occurred at a critical ratio of G to R; (b) the width of the cells varied inversely as G and inversely as R; (c) the transition from a cellular interface to a dendritic interface exhibited a large orientation dependence, and for a constant orientation breakdown occurred at a critical ratio of G to $R^{1/2}$. The experimental observations confirm both the existence of a solute-rich layer of liquid adjacent to the solid-liquid interface and its quantitative features. From this agreement with theory the diffusion coefficients of tin, silver and gold in liquid lead at 327°C are determined. This work serves to illustrate the effect of extremely small amounts of particular solutes upon the development of substructures during solidification. A technique is proposed for obtaining a measure of the purity of low impurity content alloys. A.

536.422 : 541.127

1158. ABSOLUTE THERMAL DECOMPOSITION RATES OF SOLIDS. II. THE VACUUM SUBLIMATION RATE OF MOLECULAR CRYSTALS. R.D.Schultz and A.O.Dekker.
J. chem. Phys., Vol. 23, No. 11, 2133-8 (Nov., 1955).
The linear rates of sublimation of rhombic benzene and rhombic sulphur have been calculated by use of absolute reaction rate theory in reasonable agreement with rates derived from published experimental data. Required mean torsional oscillation and translational oscillation frequencies for the molecules in the crystal lattice were obtained by an analysis of the available heat capacity and Raman spectral data. A detailed comparison of this treatment with Penner's treatment of the sublimation process is included. A.

536.422.1 : 537.525.5

1159. A METHOD FOR THE EVAPORATION OF METALS, USING AN INTERMITTENT VACUUM ARC. B.Vodar, S.Minn and S.Offret.
J. Phys. Radium, Vol. 16, No. 10, 811-12 (Oct., 1955). In French
Describes a simple arrangement for the volatilization of metals from the electrodes of an arc discharge at pressures initially ~ 10^{-5} mm Hg. It is successful with refractory metals. The following substances have been studied: C, W, Pt, Ir, Cr, Au and Zn, all of which may be evaporated. Cu and Al do not volatilize well with this arrangement. J D.Craggs

536.423 : 536.655 : 536.75

1160. RELATION BETWEEN THE PRESSURE AND BOILING POINT TEMPERATURE AND DETERMINATION OF THE MOLECULAR ENTROPY OF BOILING. J.M.Živojinov.
J. Phys. Radium, Vol. 16, No. 8-9, 693-4 (Aug.-Sept., 1955). In French.
The value of the exponent n in the equation proposed by Milosavliévitch (Abstr. 2872/1947) for vapour pressure is calculated for several liquids (H_2, N_2, HCl, $C_2H_5OC_2H_5$, NH_3, C_2H_5OH, H_2O). Using these values of n a further equation is used to calculate the entropy of vaporization at the normal boiling point. The latter are compared with experimental values. F.E.Hoare

536.423.15

1161. VAPOR PRESSURE OF HT. J.Bigeleisen and E.C.Kerr.
J. chem. Phys., Vol. 23, No. 12, 2442-3 (Dec., 1955).
Measurements on dilute solutions of HT in H_2 show that the vapour pressure of HT is greater than that of D_2 at 20°K, and they are in agreement with the rule of the geometric mean for vapour pressures of isotopic molecules. E.H.Sondheimer

536.424

1162. THE GRAPHITE–DIAMOND EQUILIBRIUM. R.Berman and J.Thewlis.
Nature (London), Vol. 176, 834-6 (Oct. 29, 1955).
Studies two recent recalculations of the graphite–diamond equilibrium diagram in the light of recent X-ray measurements of thermal expansion up to 1200°K. It is shown that Grüneisen's law holds quite accurately (with $\gamma = 1.3$) and that extrapolation according to this law supports the linear equilibrium diagram of Berman and Simon (Abstr. 8697/1955) rather than that of Liljeblad (1955) which shows a pressure maximum at about 3000°K. J.Thewlis

536.44 : 536.7

1163. THE SMALLEST PRESSURE TO PREVENT BOILING. T.Pinter.
Naturwissenschaften, Vol. 42, No. 22, 602 (1955). In German.
A thermodynamic interpretation of the empirical fact that at the critical point no equilibrium can be reached between vapour pressure and the minimum pressure required to prevent boiling. C.Turner

536.46

1164. EXPERIMENTS ON THE THERMAL RADIATION OF FLAMES. C.Codegone.
Atti. Accad. Sci. Torino I, Vol. 89, No. 2, 345-9 (1954-55). In Italian.
See Abstr. 7904 (1955). The relation connecting the energy radiated with the geometric dimensions of flames, has been approximately verified by experimental results obtained using a gas-turbine combustion chamber. The experimental arrangements are described and values of the thermal mean free path are given for different air/fuel ratios. The flame length decreased and the mean absorption coefficient of the gaseous medium tended to increase as the ratio increased. A more exact relation, derived from these results, is to be given in a later paper. J.J.Phipps

536.46

1165. GASEOUS DETONATIONS. VII. A STUDY OF THERMODYNAMIC EQUILIBRATION IN ACETYLENE-OXYGEN WAVES. G.B.Kistiakowsky and W.G.Zinman.
J. chem. Phys., Vol. 23, No. 10, 1889-94 (Oct., 1955).
For Pt VI. see Abstr. 2511 (1955). The observed detona-

tion velocities in acetylene-oxygen mixtures containing from 5 to 50% acetylene and thermohydrodynamic calculations which assume complete equilibrium to be attained in the Chapman–Jouguet plane agree within 0.5%. This is of special interest because in successive parts of this composition range each of the several reactions, viz. dissociation of excess oxygen, carbon dioxide, water, and hydrogen becomes the main endothermic process. Temperatures may be calculated from the detonation velocities which agree with the theoretical equilibrium values to better than 1% over the range from 3000 to 4500°K. In acetylene-oxygen mixtures containing 53 and 55% of the former, the observed detonation velocities agree with equilibrium calculations only when it is assumed that unsaturated carbon vapour, taken to be in equilibrium with unburned acetylene, had 170 kcal as its heat of sublimation. The velocities in mixtures containing from 60 to 70% acetylene agree quite well with calculations assuming homogeneous equilibrium. However, supersaturation of carbon vapour with respect to the solid must be assumed. In mixtures containing 71% acetylene a sudden rise in detonation velocity is observed partway down the tube. The final velocity, as well as the constant velocities in still richer mixtures, are consistent with calculations assuming complete equilibrium, including solid carbon. The discontinuity observed with 71% mixtures is interpreted as the overtaking of the Chapman–Jouguet plane of the primary detonation wave by a secondary shock wave developed by the delayed precipitation of carbon. It is suggested that because of the dependence of the delays of nucleation on the degree of supersaturation of a vapour, high velocities corresponding to complete equilibrium could be observed with leaner mixtures also if detonation velocities were measured far enough from the point of initiation. A.

536.461

1166. FLAME STRUCTURE STUDIES. III. GAS SAMPLING IN A LOW-PRESSURE PROPANE-AIR FLAME. R.Friedman and J.A.Cyphers.
J. chem. Phys., Vol. 23, No. 10, 1875-80 (Oct., 1955).

A previous investigation of this series (Abstr. 7368/1954) showed that the temperature in a very lean, low-pressure propane-air flame continues rising for more than a centimetre downstream from the zone of blue luminosity. This suggested a two-stage combustion process: (I) the hydrocarbon oxidizes rapidly and luminously to carbon monoxide; (II) the carbon monoxide oxidizes more slowly to carbon dioxide. The current gas-sampling study has provided support for this hypothesis. Both water-cooled and uncooled probes have been used to obtain gas samples from the region of the flame just beyond the luminous zone. Tests were made to insure that reaction-quenching in the probe was effective and that flame disturbance was minimized. Gas analyses were performed both mass spectrometrically and by a vacuum-freezing technique. Most of the samples were taken from a flame burning at 46 mm Hg abs. pressure, with a mass air–propane ratio of 30. Substantial proportions of CO, and about ⅛ as much H_2, were found as much as a centimetre downstream from the luminous zone, with probes of much less than a millimetre dia. The CO concentration decayed exponentially with distance; a kinetic analysis yielded a decay constant of 231 reciprocal seconds. (The flame temperature was 1605°K.) The H_2/CO ratio was considerably less than that corresponding to water-gas equilibrium in the flame. No traces of hydrocarbons were found beyond the luminous zone. A.

536.48

1167. SECOND VIRIAL COEFFICIENTS OF He^3–He^4 MIXTURES BETWEEN 2 AND 4°K. W.E.Keller.
Phys. Rev., Vol. 100, No. 4, 1021-2 (Nov 15, 1955).

PV isotherms of a gaseous mixture containing 54.75 atomic percent He^3, 45.25 He^4 have been measured at 2.146 and 3.944°K. The values of the second virial coefficients, B_{mix}, obtained from these isotherms are, respectively, −144.5 and −70.0 cm³/mole, as compared with −144.9 and −72.8 cm³/mole computed from the experimentally determined second virial coefficients of the pure components and the theoretical solution nonideality parameter. It is shown that the solutions are very nearly ideal and that in the temperature range 2 to 4°K reliable values of B_{mix} can be obtained for all compositions. A.

536.48

1168. THE ZERO-POINT KINETIC ENERGY OF LIQUID HELIUM. D.G.Henshaw and D.G.Hurst.
Canad. J. Phys., Vol. 33, No. 12, 797-800 (Dec., 1955).

This was calculated from the interatomic potential, the latent heat of vaporization, and atomic distributions derived from neutron diffraction measurements. Calculations were carried out for two liquid temperatures and several published interatomic potential functions. The resulting values of the "zero-point temperature" lie between 9.0°K and 12.6°K. A.

536.48

1169. COMPRESSIBILITY AND HEAT TRANSFER OF HELIUM II. H.Forstat and C.A.Reynolds.
Phys. Rev., Vol. 101, No. 2, 513-18 (Jan. 15, 1956).

It is demonstrated that the thermomechanical effect operates in a closed system of helium II. This effect has been used to measure the compressibility of helium II. The results agree relatively well with the results of other investigators who used other methods. The agreement indicates that the method used, a packed column of rouge in a closed system, is a good one for obtaining the full thermomechanical effect. The heat transfer of helium II in the rouge column has been measured. The behaviour found is, in general, similar to that found for the heat transfer through a slit between two optically polished surfaces. Evidence was found for a maximum in the heat transfer close to, but below, the lambda point. A.

536.48 : 532.7

1170. INTERATOMIC CORRELATIONS IN LIQUID He^4. L.Goldstein.
Phys. Rev., Vol. 100, No. 4, 981-91 (Nov. 15, 1955).

The direct correlation functions, of generally short-range character over most of the liquid temperature interval, have been obtained with the liquid He^4 X-ray scattering data of Reekie, using the 701 IBM Electronic Calculator. The geometrical simplicity of these functions when compared with the indirect correlation functions, of more intuitive physical significance, is automatically demonstrated. They closely satisfy two types of integral test relations, and this fact proves their over-all correct character and the internal consistency of the numerical analysis. The previously obtained indirect correlation functions are used in studying the interference properties of the liquid in slow-neutron scattering processes, in the limiting static approximation. At temperatures not too close to the critical region, the static interference integrals are always negative as a result of the preponderant destructive interference effects arising from the local density defects from the mean density, outweighing the local density excesses. At short and moderate neutron wavelength where the use of the static interference integrals is better justified, the total slow-neutron scattering cross-sections in liquid He^4, and in liquids in general, always increase with increasing temperature. The static interference integrals will be shown to provide an additional integral test on the indirect correlation functions. The latter were found to satisfy this test relation with good accuracy. Part of this paper is devoted to a numerical evaluation of mean kinetic energies per liquid He^4 atom as a function of the temperature. The existence of a large zero-point kinetic energy of the liquid as compared with the kinetic energy of thermal origin is demonstrated. Furthermore, the previously given qualitative proof of the kinetic energy origin of the lambda-transition could be made semiquantitative. Finally, root-mean-square forces acting on a liquid atom are evaluated, this physical quantity of elementary character having become, in principle at least, accessible through the experimental investigation of slow-

neutron scattering properties of liquids. A.

536.48

1171. SUPERFLUIDITY OF AN IDEAL BOSE–EINSTEIN GAS. J.M.Blatt and S.T.Butler.
Phys. Rev., Vol. 100, No. 2, 476-80 (Oct. 15, 1955).

An equilibrium superfluid is defined as a substance whose moment of inertia in thermal equilibrium is less than the classical value. The ideal Bose–Einstein gas below its transition temperature is shown to be an equilibrium superfluid. However, a more detailed analysis of the relation between angular momentum and angular velocity shows that experiments carried out with practical angular momenta and velocities would give an abnormally large apparent moment of inertia in thermal equilibrium, i.e., the gas would appear to be an "infra-fluid." Nevertheless, a weakly interacting Bose–Einstein gas can be used as a model of a superfluid, if the superfluid state is assumed to be metastable rather than the thermodynamic equilibrium state. A.

536.5.081 : 536.6.081

1172. HEAT UNITS AND TEMPERATURE SCALES FOR CALORIMETRY. H.F.Stimson.
Amer. J. Phys., Vol. 23, No. 9, 614-22 (Dec., 1955).

The General Conference on Weights and Measures adopted the International Temperature Scale (practical scale) in 1927 and its first revision in 1948. This scale is nearly parallel to the thermodynamic scale, proposed by Kelvin in 1854. In 1954 the General Conference redefined the Kelvin Scale, in the manner which Kelvin originally said "must be adopted ultimately", by assigning a value for the temperature of a single fixed point, viz. 273.16° for the triple point of water (ice point = 273.15°). Several calories have been used in the past but the joule was adopted for the unit of quantity of heat in 1948. The need is stressed for using units of heat which are unambiguous. A.

536.587

1173. AN ELECTRONIC THERMOREGULATOR.
J. Skotnický.
Slaboproudý Obzor, Vol. 16, No. 8, 422-4 (1955). In Slovak.

The device described is mains supplied and consists of a single thermionic tube (double diode-pentode) and a gas filled mercury relay. A mercury-filled contact thermometer is connected in the grid circuit of the valve and, upon the thermometer providing a short circuit, the valve becomes non-conducting. Consequently, the gas in the relay contracts, the relay breaks and the amount of heat supplied to a controlled device (thermostat) is reduced. Conversely, when the thermometer is open-circuited the valve is made conducting and the relay operates again. Negative bias to the valve is provided by its diode sections. A detailed circuit diagram of the regulator is given. R.S.Sidorowicz

536.587

1174. ELECTRON BOMBARDMENT FURNACE TEMPERATURE CONTROLLER. W.A.Rocco and G.W.Sears.
Rev. sci. Instrum., Vol. 27, No. 1, 1-2 (Jan., 1956).

A controller is described which operates over a wide temperature range with excellent stability. The controller uses a high gain servo amplifier system to maintain constant bombardment current. The bombardment voltage is held fixed over a wide current range by a constant voltage power supply. Temperature constancy of about 0.1% at 1600-1800° C is maintained over a several hour period. A.

536.62

1175. NEW METHOD OF FLOW CALORIMETRY.
J.G.Hoxton and R.A.Weiss.
Rev. sci. Instrum., Vol. 26, No. 11, 1058-60 (Nov., 1955).

A relative method has been developed whereby two conventional flow calorimeters, connected in a series combination, serve to determine the ratio of the C_p of a fluid in one state to that in another, this ratio being measured as a function of resistance ratios. Measurements of flow rate and of power input are not required, while simplifications in other respects are also to be found. Although its determinations are not "absolute", the gains in speed and simplicity, without loss of accuracy, are considered sufficient to warrant its use in exploratory work or in researches requiring the extensions of known values over new temperatures and pressures, as is often the case with tables. A.

536.63 : 538.222

THERMAL PROPERTIES OF UI_3 AT LIQUID HELIUM TEMPERATURE. See Abstr. 478.

536.631

1176. SPECIFIC HEAT OF GRAPHITE AT VERY LOW TEMPERATURES. W.DeSorbo.
J. chem. Phys., Vol. 23, No. 10, 1970-1 (Oct., 1955).

Reports results of measurements on two graphite specimens between 1.5° and 20° K. The electronic heat coefficient γ was found to have values 1.1 and 3.8 x 10^{-8} cal.mol^{-1}.deg^{-2} for the two specimens, and the lattice specific heat to be proportional to T^n, where n is about 3 at about 3° K, decreasing to about 2 at 20° K (transition from an effective 3-dimensional to 2-dimensional structure). The thermal properties of graphite were found to be sensitive to the physical and chemical state of the specimens (crystal size, gas and ash content, presence of lattice faults). E.P.Wohlfarth

536.631

1177. HEAT CAPACITY OF ERBIUM FROM 15 TO 320° K.
R.E.Skochdopole, M.Griffel and F.H.Spedding.
J. chem. Phys., Vol. 23, No. 12, 2258-63 (Dec., 1955).

The heat capacity has been measured and the thermodynamic functions calculated. Three maxima have been observed which occur at 19.9° K, 53.5° K and 84° K. The two at the lower temperatures show a dependence on the thermal history of the sample, and this dependence was investigated. A correlation of the various contributions to the entropy at room temperature has been made and extended to the other rare earth metals. A.

536.631 : 536.75 : 538.221

1178. HEAT CAPACITY AND ENTROPY OF FeF_2 AND CoF_2 FROM 11 TO 300° K. THERMAL ANOMALIES ASSOCIATED WITH ANTIFERROMAGNETIC ORDERING.
E.Catalano and J.W.Stout.
J. chem. Phys., Vol. 23, No. 10, 1803-8 (Oct., 1955).

The heat capacities of FeF_2 and CoF_2 have been measured between 11 and 300° K. Both salts show anomalies in heat capacity associated with the antiferromagnetic ordering of the magnetic ions. The heat capacity of FeF_2 exhibits a sharp maximum of 17.8 cal.deg^{-1}.mole^{-1} at 78.35° K and that of CoF_2 has a maximum of 5.64 cal.deg^{-1}.mole^{-1} at 37.70° K. Values of the heat capacity, entropy, enthalpy and free energy are tabulated at selected temperatures. The values of the entropy and enthalpy at 298.16° K are: FeF_2, $S^0 = 20.79 \pm 0.04$ cal.deg^{-1}.mole^{-1}, $H^0 - H_0^0 = 3049 \pm 6$ cal.mole^{-1}; CoF_2, $S^0 = 19.59 \pm 0.04$ cal.deg^{-1}.mole^{-1}, $H^0 - H_0^0 = 2978 \pm 6$ cal.mole^{-1}. A.

536.631 : 539.4.016.3

1179. SPECIFIC-HEAT MEASUREMENTS ON QUENCH-ANNEALED Al, Cu AND α-PHASE ALLOYS OF Cu.
K. Hirano, H.Maniwa and Y.Takagi.
J. Phys. Soc. Japan, Vol. 10, No. 10, 909-10 (Oct., 1955).

After quenching pure Al and Cu from 600° C and annealing at 130° C for about 100 hr, the specific heat is measured and compared with annealed specimens in runs of mean heating rate of about 3° C/ minute. An anomalously high value is found between 150° C and 350° C, and is attributed to the evaporation of vacancy aggregates. W.M Lomer

536.631 : 548.7

1180. SPECIFIC HEAT OF LAMELLAR CRYSTALS. G.F.Newell.
J. chem. Phys., Vol. 23, No. 12, 2431-8 (Dec., 1955).

The theoretical basis for expecting the specific heat of lamellar crystals to be proportional to T^2, at least over a sizeable range of temperatures, is re-examined and criticized in a qualitative way starting from the Born–von Kármán model of lattice vibrations. Arguments are presented to indicate that such a behaviour implies special properties of the molecular forces other than those to be expected simply because of the lamellar structure. Numerous possible hypotheses are considered along with their consequences. From this it seems doubtful that there is any simple semiphenomenalogical law that will fit specific heat data for all lamellar crystals in a manner comparable to the Debye law for nearly isotropic materials. A.

THERMODYNAMICS 536.7/.8

536.7

1181. HOMOGENEITY CONDITION IN THERMODYNAMICS. H.A.Bent.
J. chem. Phys., Vol. 23, No. 11, 2199 (Nov., 1955).

A generalized mathematical discussion is given of the fact that the energy of a stable thermodynamic system is a homogeneous function of its entropy, volume and mass numbers. It is stated that proofs in the literature assume properties for some variables which can be derived only from the homogeneity condition itself, or its equivalent. F.E.Hoare

536.7 : 537.222

1182. THERMODYNAMICS OF A FLUID SUBSTANCE IN THE ELECTROSTATIC FIELD. H.S.Frank.
J. chem. Phys., Vol. 23, No. 11, 2023-32 (Nov., 1955).

An "apparatus" is described in which, in a thought experiment, the whole of a sample of fluid may be subjected to a uniform electrostatic field under controlled conditions. The work done in such a process can be written into fundamental thermodynamic equations so as to enable the field strength E to be a variable of state in a way which is essentially symmetrical with the way in which P and T are variables of state. This enables a variety of differential coefficients to be obtained, some of which appear to be new. A discussion is given of the relationship between "electrostriction pressure" (as derived in electrostatics) and thermodynamic pressure. Application of the formalism to systems of more than one component is illustrated by discussion of the change in composition produced by charging the plates of a small condenser immersed in a large volume of binary fluid mixture. The customary representation of the "energy density" in a field as equal to $E^2K/8\pi$ is discussed, and found to be limited in formal validity when the field is nonuniform, when the charging process takes place under conditions which do not hold the volume constant, or when dielectric saturation is taken into account. A.

536.71 : 532.7

1183. EXAMINATION OF THE EXPRESSION $T(dp/dT)_V + B = f(v)$, FOR A NUMBER OF HIGH PURITY LIQUID HYDROCARBONS. W.G.Cutler, W.Webb and R.W.Schiessler.
J. chem. Phys., Vol. 23, No. 12, 2466-7 (Dec., 1955).

If a Van der Waals type equation of state for liquids were correct $(dp/dT)_V$ should be a function of volume only. This is not so however, whereas the quantity $T(dp/dT)_V + B$ has already been shown to be a function of volume only for benzene, its derivatives and some paraffins. The authors show that this is also so for a number of liquid hydrocarbons. T.C.Toye

536.75

1184. ENTROPY REQUIREMENTS OF THE HAMMETT RELATIONSHIP. J.E.Leffler.
J. chem. Phys., Vol. 23, No. 11, 2199-200 (Nov., 1955).

The existence of a Hammett equation, relating reaction-rate constants to structural parameters, being assumed at a given temperature, the constraint on the entropy of activation necessary to make the relationship hold at another temperature is investigated. Contrary to the assumption sometimes made that the entropy must be constant it is shown that it may be related linearly to the activation enthalpy. F.E.Hoare

536.75 : 532 739

1185. USE OF THE LATTICE MODEL FOR ENTROPY CALCULATIONS. F.Bueche and W.R.Krigbaum.
J. chem. Phys., Vol. 23, No. 10, 1863-5 (Oct., 1955).

The influence of choice of cell size upon the calculated entropy of mixing of solutions is discussed. It is shown that the lattice type calculation, when properly applied, leads to the same result for all possible choices of cell size. A new method is presented for calculating the entropy of mixing which does not assume a lattice. This method confirms the result of the lattice calculation. A.

ELECTRICITY 537

537.12

1186. MILLIKAN'S OIL DROP EXPERIMENT. H.Straubel.
Naturwissenschaften, Vol. 42, No. 18, 506-7 (1955). In German.

A short note describing a modified version of the experiment in which motion of the charges is caused by a modulating electric field. C.G.Morgan

ELECTROSTATICS. DIELECTRICS 537.2

537.213

1187. THE VIBRATING CONDENSER ELECTROMETER. M.Brière and J.Weill.
J. Phys. Radium, Vol. 16, No. 8-9, 695-703 (Aug.-Sept., 1955). In French.

A discussion is given of the design of this type of electrometer, followed by a detailed description of a particular instrument. This can measure a potential of 100 microvolts across an input resistance of 10^{12} ohm. By observing the rate of charging-up of a standard condenser currents less than 10^{-16} amp can be measured. Zero drift is about 0.1 to 0.5 millivolt a day. A.E.Kay

537.222.2

1188. DISTRIBUTION OF POTENTIAL IN CARBON TETRACHLORIDE SUBJECTED TO A D.C. VOLTAGE (FIELDS LESS THAN 1500 V/cm). R.Guizonnier.
J. Phys. Radium, Vol. 16, No. 7, 58 S - 60 S (July, 1955). In French.

Measurements were made using a probe connected to an electrometer via a condenser. The voltage was applied between two plane nickel electrodes. The results showed that space charge of the same polarity as the charged electrode accumulated near the earthed electrode, even for commercial carbon tetrachloride which had been purified and dried. Whe either both electrodes or only the charged one was varnished with an insulating lacquer, a uniform field was produced between the electrodes. However space charge developed when only the earthed electrode was varnished and is due to the action of the charged electrode on the liquid, particularly on the particles of water it contains. A.E.Ka

537.226

1189. QUANTITATIVE COMPARISON OF THE APPROXIMATE DIELECTRIC POLARIZATION THEORIES WITH AN EXACT ONE AT LOW DENSITIES. A.D.Buckingham.
J. chem. Phys., Vol. 23, No. 12, 2370-5 (Dec., 1955).

The total dielectric polarization of a polar gas is expanded in inverse powers of the molar volume and the first term representing deviations from ideal gas behaviour evaluated for an assembly of point polarizable dipoles, using the method developed by Buckingham and Pople. The approximate dielectric polarization equations of Debye, Onsager, Kirkwood, and Harris and Alder are expanded similarly and the corresponding coefficients of the term proportional to the first power of the density compared with the exact one. There is no term proportional to the density in the equations of Debye and of Onsager; also, to this order Kirkwood's and Harris' and Alder's theories are equivalent, both somewhat underestimating the total polarization. The use of Onsager's relationship for the dipole moment of a molecule is shown to be inappropriate for an imperfect gas. A.

537.226.1.08

1190. ON THE MEASUREMENT OF THE DIELECTRIC CONSTANTS OF LIQUIDS IN THE DECIMETRE WAVE REGION. T.Jäkel.
Ann. Phys. (Leipzig), Vol. 17, No. 1, 42-54 (1955). In German.

A concentric Lecher system, partly filled with liquid, is used to determine ϵ' and ϵ'' from the change of resonance condition with sample thickness at a fixed frequency. Results at 30 cm and 20-60° C are given for methyl alcohol and isobutyl alcohol solutions in benzene. D.H.Whiffen

537.226.2

1191. DIELECTRIC BEHAVIOUR OF VARIOUS CLAYS IN RELATION TO THEIR WATER CONTENT, MEASURED AT DECIMETRE WAVELENGTHS. E.Deeg and O.Huber.
Naturwissenschaften, Vol. 42, No. 18, 507 (1955). In German.

The specific polarizability of a mixture of clay and water varies linearly with the water content, if this exceeds some 20%. Polarization measurements may be a useful means for assessing the water content required for a given plasticity of the mixture. J.H.Mason

537.226.2

1192. DIELECTRIC PROPERTIES OF LIQUID ETHANOL AND 2-PROPANOL. F.X.Hassion and R.H.Cole.
J. chem. Phys., Vol. 23, No. 10, 1756-61 (Oct., 1955).

Dielectric constants and loss were measured from room temperature to −160° C for the pure liquids and mixtures with small amounts of water to facilitate supercooling. Two distinct dispersion regions were found below −100° C in the experimental frequency range from 1 c/s to 5 Mc/s. The temperature dependences are similar and described by rate laws of the form found for similar measurements in 1-propanol. An explanation of the multiple dispersions in terms of hydrogen bond breaking to permit reorientation of alkyl and hydroxyl groups is discussed. A.

537.226.2

1193. ISOTHERMAL PRESSURE DEPENDENCE OF THE DIELECTRIC PROPERTIES OF EUGENOL, GLYCEROL AND WATER. B.K.P.Scaife.
Proc. Phys. Soc. B, Vol. 68,Pt 10, 790-2 (Oct., 1955).

Permittivity and dielectric loss measurements at pressures up to 10 000 kg/cm^2 confirm that anomalous dispersion occurs at high pressures. J.H.Mason

537.226.2

1194. A NEW DIELECTRIC DISPERSION IN LONG-CHAIN NORMAL PRIMARY ALCOHOL OF PROBABLE CARBON NUMBER 32 AT LOWER TEMPERATURE PHASE. T.Takamatsu.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1049-84 (Dec., 1955).

Certain normal long-chain alcohols are well known for their anomalous dielectric properties in higher temperature phase, which are often attributed to molecular rotation in the crystal lattice. The present article describes experiments on the anomalous dielectric dispersion of a long-chain normal primary alcohol of probable carbon number 32, extracted from Carnauba wax. The higher temperature phase (68°-86° C) has the same dielectric behaviour as that already known in hexadecyl and octadecyl alcohol. But on the other hand, in the lower temperature phase a new dispersion of Debye type was observed. The relaxation time seems to have a certain distribution, and the activation energy estimated from relaxation time versus inverse absolute temperature curve is 26.4 kcal/mol. The dispersion is considered to be due to the reorientation of O—H group as a result of the restricted rotation or twisting of the molecule. A.

537.226.2

1195. FERROELECTRIC HYSTERESIS IN BARIUM TITANATE SINGLE CRYSTALS. H.H.Wieder.
J. appl. Phys., Vol. 26, No. 12, 1479-82 (Dec., 1955).

The properties of the dynamic hysteresis loop of a c-domain single crystal are examined as a function of temperature. Experimental results indicate that the coercivity and hysteresis losses decrease sharply as the crystal passes through a phase transition to a lower order of symmetry. This occurs without a substantial loss in loop rectangularity. The properties of a theoretical model for the hysteresis loop are derived from the Devonshire thermodynamic equations and previously defined experimental parameters. In the tetragonal and orthorhombic crystal phases good agreement is obtained between the behaviour predicted for the theoretical model and the experimental observations made on a c-domain. A.

537.226.2 : 541.15

1196. CHANGES OF THE DIELECTRIC CONSTANT OF ORGANIC MATERIALS INDUCED BY X-RADIATION. H.Glubrecht and E.G.Niemann.
Naturwissenschaften, Vol. 42, No. 21, 576-7 (1955). In German.

X-radiation increases the dielectric constants of some organic materials. The increase is proportional to dose under the conditions employed, 80 kV, 140 r per minute and 280 r per minute. A schematic description of the measuring technique is given. The apparatus measures changes of 10^{-5} in the dielectric constant. Detailed results are reported for p-dichlorobenzene. The changes in the dielectric constant per 1000 r were found to be 0.25×10^{-3} for p-dichlorobenzene; 0.22×10^{-3} for alanine; 0.18×10^{-3} for glycine; 0.37×10^{-3} for cysteine; 2.90×10^{-3} for casein; 1.44×10^{-3} for gelatine (dry); and 0.95×10^{-3} for glass. It is suggested that the high values found for the two proteins are due to the formation of radicals with a marked electrical asymmetry. M.Ebert

537.226.3.08 : 539.11

1197. STUDIES OF THE ENERGY LEVELS OF SOLIDS BY THE METHOD OF DEBYE ABSORPTION. R.Rohmer, M.Freymann and R.Freymann.
Onde élect., Vol. 35, 465-7 (May, 1955). In French.

Discussion of the methods of measuring dielectric absorption in solids, particularly powdered semiconductors. The results enable speculations to be made about lattice defects in the materials examined. The methods are exemplified by results on ZnO. C.A.Hogarth

537.226.31

1198. DIELECTRIC ABSORPTION OF TRIETHYLAMINE SOLUTION. M.Davies and A.H.Price.
J. chem. Phys., Vol. 23, No. 11, 2204 (Nov., 1955).

A previously-reported "resonance" absorption (Abstr. 8259/1954) for solutions of triethylamine in Nujol (medicinal

paraffin) is now explained away by the viscosity-dependence of the magnitude and peak-position of the background loss of the Nujol. F.F.Roberts

537.226.31 : 548.7

1199. DIELECTRIC LOSSES OF VARIOUS MONOCRYSTALS OF QUARTZ AT VERY LOW TEMPERATURES. J.Volger, J.M.Stevels and C.van Amerongen.
Philips Res. Rep., Vol. 10, No. 4, 260-80 (Aug., 1955).

Between 14 and 150°K the tan δ v. T curve of quartz, measured at frequencies of 1 or 32 kc/s, may show a variety of maxima. The relaxation phenomena involved are correlated with both primary and radiation-induced lattice defects. Results of experiments with clear quartz, artificially irradiated quartz, natural smoky quartz and amethyst are reported. A discussion related to the nature of a number of lattice imperfections is given. A.

537.226.33

1200. DIELECTRIC RELAXATION IN SODIUM CHLORIDE CRYSTALS. G.Jacobs.
Naturwissenschaften, Vol. 42, No. 21, 575-6 (1955).

Measurements of dielectric loss as a function of frequency in the range 100 c/s to 100 kc/s on crystals of pure NaCl crystals and on crystals containing 0.3 mole % of $CaCl_2$ are reported. The anomaly previously reported by Breckenridge is found to be due not to a relaxation of the complex cation-anion vacancies but to some other cause. C.A.Hogarth

537.226.33 : 621.315.616.96

1201. INVESTIGATION OF THE RELAXATION PROCESSES IN POLYVINYL ACETATE AT TEMPERATURES BELOW THE SOFTENING TEMPERATURE. P.F.Veselovskiĭ and A.I.Slutsker.
Zh. tekh. Fiz., Vol. 25, No. 5, 939-42 (1955). In Russian.

The investigation covered the temperature range (−150° to +20°C) and frequency range 50–10^{10} c/s. At room temperature tan δ has a low maximum which at lower temperatures shifts towards lower frequencies, indicating the relaxation character of the dielectric losses. Plastification and interlinkage of the polar radicals hardly affect the frequency relation of tan δ. Results seem to confirm Kobeko's hypothesis that the polarization losses in polar polymers below softening temperature are due to the thermal movements of the polar radicals. The polymer chains are practically immobilised.
Electrical Research Association

537.226.33 : 621.315.616.96

1202. INVESTIGATION OF RELAXATION PROCESSES IN POLYVINYL ACETATE. P.F.Veselovskiĭ and A.I.Slutsker.
Zh. tekh. Fiz., Vol. 25, No. 7, 1204-8 (1955). In Russian.

The dielectric losses in polyvinyl acetate were measured in a wide temperature range above the softening temperature at the frequency 1.6 kc/s. The experimental results were then evaluated by considering a relation of the form $\phi(\log f - 1/T)$, where f and T are frequency and temperature at which tan δ is a maximum. Comparison with results obtained for solid p.v.a. enables the two components distinguished as dipolar-elastic losses and dipolar-radical dielectric relaxation losses to be separated.
Electrical Research Association

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.32

1203. ULTRASHORT LIGHT AND VOLTAGE PULSES APPLIED TO SILVER HALIDE CRYSTALS BY TURBINE-DRIVEN MIRROR AND SPARK-GAP SWITCH. J.H.Webb.
J. appl. Phys., Vol. 26, No. 11, 1309-15 (Nov., 1955).

Studies of electron mobility in silver halide crystals have been carried out by Haynes and Shockley by means of ultrashort light and voltage pulses applied simultaneously to large, single crystals of these materials. Their apparatus made use of a radar-type, pulse-forming network discharged through mercury spark-gap tubes. An apparatus for carrying out this same type of experiment has been developed using an air-driven turbine with a mirror and a spark-gap switch. Repetitive light pulses of 3.33 microsecond duration and voltage pulses of 10 kV and about 20 microsecond duration can be applied to a crystal at a rate of 500 per second. The light and voltage pulses can be initiated simultaneously or at controlled time intervals. The simplicity and practicality of this type of apparatus for electron mobility and photolysis studies on the silver halides are illustrated by experimental results. Light pulses from a mercury arc release photoconduction electrons in the surface of a silver chloride crystal. The voltage pulse pulls the liberated electrons in a straight column for varying distances through the crystal, where they become trapped. This is shown by the direct photolysis along the column in the crystal. Also, print-out silver specks produced in large photographic grains are displaced to one side of the grains by the voltage pulses applied during exposure. The displacement is in the direction that electrons are pulled in the applied field. By separation of the light pulse and voltage pulse in time, the mean lifetime of the photoliberated electrons can be studied. The lifetime of the electrons was found to be approximately 10 microseconds, of the same order as that of electrons in large, well-annealed single crystals of silver chloride. A.

537.311.32 : 537.533.9

1204. IRRADIATION OF GRAPHITE AT LIQUID HELIUM TEMPERATURES. S.B.Austerman and J.E.Hove.
Phys. Rev., Vol. 100, No. 4, 1214-15 (Nov. 15, 1955).

The results of pulse annealing experiments on electron irradiated graphite are quoted. The resistivity was measured at 4°K; it is found that the resistivity is markedly increased by annealing in the range 80-200°K. Temperatures below 80°K have no effect, and results agree qualitatively with liquid air proton and neutron irradiation experiments.
W.M.Lomer

537.311.33

1205. STATISTICAL KINETIC THEORY OF LUMINESCENCE AND ELECTRICAL CONDUCTIVITY OF DEFECT SEMICONDUCTORS. I.Broser and R.Broser-Warminsky.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 361-407 (1955). In German.

The general problem of relating the electrical and optical properties of semiconductors (especially crystal phosphors) to the energy-band system for crystal lattice and lattice defects is discussed. It is shown that the two types of charge carriers (electrons and holes) form two groups each with its own Fermi distribution, and that interactions between the two are involved in excitation and emission of photons. The main characteristics of luminescence can be deduced from the general theory developed without a detailed knowledge of defect level distribution. G.F.J.Garlick

537.311.33

1206. NEW METHOD OF DETERMINING THE THERMAL CHARACTERISTICS OF SEMICONDUCTORS. M.A.Chernyakova and A.F. Chudnovskiĭ.
Zh. tekh. Fiz., Vol. 25, No. 6, 1013-18 (1955). In Russian.

The following characteristics are considered theoretically: thermal conductivity, thermal volume capacity, temperature conductivity and coefficient of heat assimilation, the first pair of which are fundamental, and the second derived, characteristics. The method of measurement presented is the first enabling all four characteristics, as well as the electrical conductivity, to be determined in the same set-up, viz an unbalanced bridge, and using alternatively a loop oscillograph, a galvanometer and Kondratiev's "λ-calorimeter".
Electrical Research Associatio

537.311.33

1207. GENERATION OF 1/f NOISE BY LEVELS IN A LINEAR OR PLANAR ARRAY. S.R.Morrison.
Phys. Rev., Vol. 99, No. 6, 1904 (Sept. 15, 1955).

Trapping levels at a linear or planar array of edge dislocations on the surface will trap charges which will cause a potential barrier to any further trapping of charges of similar sign. A fluctuation in trapped charge will cause a consequent fluctuation in barrier height. An analysis of this model leads to the usual type of excess noise law. C.A.Hogarth

537.311.33

1208. SURFACE POTENTIAL AND SURFACE CHARGE DISTRIBUTION FROM SEMICONDUCTOR FIELD EFFECT MEASUREMENTS. W.L.Brown.
Phys. Rev., Vol. 100, No. 2, 590-1 (Oct. 15, 1955).

It is possible from measurements of the change in conductance of a semiconductor with application of an electric field normal to its surface to determine both the electrostatic potential of the surface and the distribution of charge in surface states. Such determinations depend upon the uniqueness of the minimum in conductance which can be observed in these experiments, and its independence of the surface state charge. A.

537.311.33

1209. FAST-NEUTRON BOMBARDMENT OF GaSb. J.W.Cleland and J.H.Crawford, Jr.
Phys. Rev., Vol. 100, No. 6, 1614-18 (Dec. 15, 1955).

Fast-neutron irradiation decreases the carrier concentration of polycrystalline samples of n- and p-type GaSb, indicating the production of low-lying traps. Vacuum heat treatment evidently removes such traps but also introduces additional acceptors, indicating a different rate of annealing for bombardment produced interstitial and vacancy atoms. Irradiation and heat treatment of n-type GaSb therefore results in the production of material of lower carrier concentration and reirradiation results in the conversion to p-type material. Repeated irradiations followed by heat treatments, however, do not reduce the net effective concentration of electrons in n-type material below about 5×10^{17} cm^{-3}. The mobility of all samples is decreased by bombardment. Heat treatment subsequent to irradiation increases the mobility of n-type material but decreases the mobility of p-type samples still further below the decrease produced by bombardment. Low-temperature (−125° C) irradiation and subsequent warm-up and cool-down curves indicate the presence of defects of low thermal stability. No evidence was obtained for regions of low resistivity resulting from superlattice disordering as a result of quenching as might be expected from the thermal spike picture. The type and position of fast-neutron-introduced lattice defects is discussed with relation to previous models for Ge and InSb. A.

537.311.33

1210. IMPURITY BAND IN SEMICONDUCTORS WITH SMALL EFFECTIVE MASS. F.Stern and R.M.Talley.
Phys. Rev., Vol. 100, No. 6, 1638-43 (Dec. 15, 1955).

The energy levels of ordered impurities of semiconductors are formally equivalent to the energy levels of metallic hydrogen if a number of simplifying approximations are made. An approximate calculation of the energy states for the 1s band of metallic hydrogen is carried out for smaller lattice constants than those considered by Wigner and Huntington, or by Baltensperger. A simple transformation of the distance and energy scales converts the calculation for metallic hydrogen to one applying to impurities in a semiconductor, if values for the effective mass and the dielectric constant are given. Experimental results for the optical energy gap in InAs are reported as a function of impurity concentration. The effective mass required to fit the optical data for InSb published by other workers is about 0.03 m, as compared to the value 0.013 m found by cyclotron resonance measurements. A.

537.311.33 : 538.632

1211. SATURATION HALL CONSTANT OF SEMICONDUCTORS. J.A.Swanson.
Phys. Rev., Vol. 99, No. 6, 1799-807 (Sept. 15, 1955).

The asymptotic value of the Hall constant of semiconductors as the magnetic field becomes very large is shown on general grounds to be $1/(p - n)ec$, where p and n = concentrations of holes and of electrons respectively; this result is independent of the band shapes in the neighbourhood of energy maxima or minima. The unscattered motion of electrons, which determines the saturation Hall constant, is examined by means of the usual crystal momentum force equation, and also through direct investigation of the properties of stationary states in crossed electric and magnetic fields. The saturation magnetoresistance is also discussed, within the framework of the crystal momentum approximation. A.

537.311.33

1212. CYCLOTRON RESONANCE IN METALS: BISMUTH. J.K.Galt, W.A.Yager, F.R.Merritt, B.B.Cetlin and H.W.Dail, Jr.
Phys. Rev., Vol. 100, No. 2, 748-9 (Oct. 15, 1955).

Circularly polarized radiation at 24 000 Mc/s was applied to a Bi crystal surface; the steady magnetic field H was normal to the surface and parallel to the trigonal axis. The absorption coefficient followed qualitatively the curve expected for free positive holes of mass about 0.3 m_0, except for a deep trough around H = 0, attributed to holes of mass about 0.0015 m_0. See also abstract following. R.G.Chambers

537.311.33

1213. ELECTROMAGNETIC THEORY OF CYCLOTRON RESONANCE IN METALS. P.W.Anderson.
Phys. Rev., Vol. 100, No. 2, 749-50 (Oct. 15, 1955).

The theory of cyclotron resonance in a free-electron metal under classical skin effect conditions is given (see also Abstr. 8294/1954), and it is pointed out that if minority carriers of very different m^* and τ are also present, they may give rise to a trough in the absorption curve similar to that found by Galt et al. (preceding abstract). R.G.Chambers

537.311.33

1214. CYCLOTRON ABSORPTION IN BISMUTH. R.N.Dexter and B.Lax.
Phys. Rev., Vol. 100, No. 4, 1216-18 (Nov. 15, 1955).

Microwave absorption experiments on single-cleaved Bi crystals, mounted at one end of a cavity, were carried out at 23 000 Mc/s and temperatures down to 1.3° K for varying magnetic fields up to 13 000 oersted. Theory suggests the possibility of measuring effective masses and studying band structure of metals and semimetals from the derivative of absorption with respect to magnetic field. Some preliminary results are given. F.Ansbacher

537.311.33

1215. ON THE PROBLEM OF ELECTRONIC INTRINSIC CONDUCTION IN SEMICONDUCTORS. K.W.Böer.
Z. Naturforsch., Vol. 10a, No. 11, 898-9 (1955). In German.

By means of varying the heating rate of CdS crystals and measuring the electrical conductivity it is concluded from the results that no intrinsic conduction by the conventional model actually takes place at high temperatures but that conduction at these temperatures is by the motion of lattice defects which may be regarded as "intrinsic defect centres". This interpretation provides an explanation for the discrepancies found when mobility calculations are made on CdS crystals. C.A.Hogarth

537.311.33 : 535.3

1216. OPTICAL AND ELECTRICAL PROPERTIES OF GaAs, InP AND GaP. H.Welker.
J. Electronics, Vol. 1, No. 2, 181-5 (Sept., 1955).

The refractive indices and absorption coefficients of the three compounds, for the wavelength range 0.5 – 16μ, are

presented, together with Hall constant and conductivity data over wide temperature ranges. From these data values for the activation energies and their temperature variation are deduced, and mobility values calculated. The properties of mixed GaAs–GaP crystals are shown, with varying activation energies. D.G. Avery

537.311.33

1217. GRAIN-BOUNDARY STRUCTURE AND CHARGE TRANSPORT IN SEMICONDUCTOR CRYSTALS. H.F.Mataré.
Z. Naturforsch., Vol. 10a, No. 8, 640-52 (Aug., 1955). In German.

Free carriers at grain boundaries in germanium increase in number with applied field and positive space charge buildup on either side of each boundary. The latter zone is p-type and becomes more conducting as the number of electrons in unsaturated surface bands increases. In twinned crystals the narrow boundaries can give current multiplication. Theoretical treatment of correlation between carrier motion and boundary field strengths is given. G.F.J.Garlick

537.311.33

1218. EFFECT OF WATER VAPOR ON GROWN GERMANIUM AND SILICON N–P JUNCTION UNITS. J.T.Law and P.S.Meigs.
J. appl. Phys., Vol. 26, No. 10, 1265-74 (Oct., 1955).

The effect of water vapour on the photoresponse curves and reverse current characteristics of germanium and silicon n-p junction units has been investigated. It is concluded that changes in surface recombination velocity are only important at low relative humidities Channel conduction accounts for the increased current of a silicon unit but another mechanism must be postulated for the germanium case. The possibility of this being ionic conduction is discussed. A.

537.311.33

1219. NOISE IN GERMANIUM. S.Okazaki and H.Oki.
J. Phys. Soc. Japan, Vol. 10, No. 10, 910-12 (Oct., 1955).

Measurements of excess noise on Ge filaments of resistivities from 7 to 20 ohm.cm. One result is that the current noise power always increases with bias current. Assuming a $1/f^{\beta}$ frequency variation, β varies between 1 and 2, often approximating to 2. C.A.Hogarth

537.311.38

1220. CLASSICAL THEORY OF CYCLOTRON RESONANCE FOR HOLES IN Ge. J.M.Luttinger and R.R.Goodman.
Phys. Rev., Vol. 100, No. 2, 673-4 (Oct. 15, 1955).

Cyclotron resonance line shapes for holes have been calculated in the classical limit. The magnetic field was taken in the (001) direction. Because the cyclotron resonance frequency depends on the component of k parallel to the magnetic field (k_H), the line is shifted and broadened as compared to the simple theory with $k_K = 0$. The shift of the maximum is about 3%, and the broadening (which is asymmetric) is about 40% for Ge, if $\omega\tau$ is taken as 7.5. A.

537.311.33

1221. RESTORATION OF RESISTIVITY AND LIFETIME IN HEAT TREATED GERMANIUM. R.A.Logan and M.Schwartz.
J. appl. Phys., Vol. 26, No. 11, 1287-9 (Nov., 1955).

Experiments are described in which minority carrier lifetime and resistivity of germanium are altered by the addition of copper by diffusion, under conditions where extraneous chemical contamination is minimized. This copper is then gettered by heating the samples in contact with liquid lead or gold, and the resistivity and lifetime are substantially restored. The gettering process is interpreted in terms of the low distribution coefficient of copper in the ternary system which copper and germanium form with the getter. A.

537.311.33

1222. RELATIVE INFLUENCE OF MAJORITY AND MINORITY CARRIERS ON EXCESS NOISE IN SEMICONDUCTOR FILAMENTS. L.Bess.
J. appl. Phys., Vol. 26, No. 11, 1377-81 (Nov., 1955).

An experiment has been devised whereby excess noise is measured along various different directions in a germanium filament after the directions of current flow for the majority and minority carriers had been altered by a magnetic field. From this experiment it is possible to determine that whereas shot noise is caused by both majority and minority carrier fluctuation, 1/f noise is essentially produced only by majority carrier fluctuation. A.

537.311.33

1223. CYCLOTRON RESONANCE IN Ge-Si ALLOYS. G.Dresselhaus, A.F.Kip, H.-Y.Ku, G.Wagoner and S.M.Christian.
Phys. Rev., Vol. 100, No. 4, 1218-19 (Nov. 15, 1955).

Experiments were carried out at 4°K and between 24 000 and 48 000 Mc/s. Resonance lines are resolved for 5% Si in Ge alloy, whereas 10^{-5}% tri- or pentavalent impurity makes resolution difficult. The effective electron masses for 0.8% Si in Ge alloy are identical with those for pure Ge. Si rich alloy showed electron resonance only. F.Ansbacher

537.311.33

1224. TEMPERATURE DEPENDENCE OF THE ELASTORESISTANCE IN N-TYPE GERMANIUM. R.W.Keyes.
Phys. Rev., Vol. 100, No. 4, 1104-5 (Nov. 15, 1955).

An explanation of the large elastoresistance effects discovered by Smith has been proposed by Herring and by Adams Smith's preliminary measurements of the temperature dependence of the effect are not in agreement with this explanation. A more extensive study of the temperature dependence of the elastoresistance in n-type germanium shows that the magnitude of the effect is proportional within experimental error to T^{-1}, a result which is consistent with the theory. A.

537.311.33

1225. CONDUCTIVITY, HALL EFFECT, AND MAGNETORESISTANCE IN N-TYPE GERMANIUM, AND THEIR DEPENDENCE ON PRESSURE. G.B.Benedek, W.Paul and H.Brooks.
Phys. Rev., Vol. 100, No. 4, 1129-39 (Nov. 15, 1955).

Measurements of the electrical resistance, low-field Hall effect, and low-field longitudinal and transverse magnetoresistance in oriented samples of n-type germanium in which the carriers are all of one type have been carried out at 0° C as a function of pressure in the range 1-10 000 kg/cm² by using a nonmagnetic beryllium–copper high-pressure bomb. The experimental results are interpreted in terms of a low-field theory for n-type germanium in which the shape parameter $K = m_1/m_2$ of the energy ellipsoids and the dependence of the collision time τ on energy play a central role. The atmospheric-pressure data indicate that K at 0° C is probably different from the low-temperature cyclotron resonance value. Consideration of several possible forms of the energy dependence of τ leads to the adoption for lattice scattering of a phenomenological law of the form $\tau_L = (a/kT)\epsilon^{-p}$. It is found that the inclusion of the effects of even a small amount of impurity scattering plays a significant role in determining the magnitudes of the galvanomagnetic coefficients. By assuming a reasonable amount of impurity scattering in samples it is possible to obtain an expression for $\tau(\epsilon)$ which is capable of producing the magnitudes of the galvanomagnetic coefficients as well as their temperature dependence. The variation of the galvanomagnetic coefficients with pressure is interpreted in terms of changes in K and the form of the dependence of τ on energy. In particular it is found that K decreases with increasing pressure, indicating that the application of pressure causes the energy ellipsoids to become less prolate. The change in the energy dependence of τ is interpreted in terms of a change in the exponent of the energy in the lattice scattering law. A.

537.311.33

1226. EFFECTS OF THE DISLOCATIONS ON MINORITY CARRIER LIFETIME IN GERMANIUM. J.Okada.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1110-11 (1955).

Measurements on n-type single-crystal Ge to compare the carrier lifetime due to dislocations distributed at random with the recombination velocity due to the dislocations along a grain boundary. A.E.De Barr

537.311.33

1227. THE DEPENDENCE OF THE BARRIER PHOTO-EFFECT ON X-IRRADIATION. J.Braunbeck and J.Zakovsky.
Naturwissenschaften, Vol. 42, No. 22, 602-3 (1955). In German.

Experiments on the effect of X-irradiation on the emitter and collector currents of germanium transistors are briefly reported. C.A.Hogarth

537.311.33

1228. AMPHOTERIC IMPURITY ACTION IN GERMANIUM. W.C.Dunlap, Jr.
Phys. Rev., Vol. 100, No. 6, 1629-33 (Dec. 15, 1955).

A new type of impurity action in germanium is described. This is "amphoteric" impurity action, to be contrasted with "donor" and "acceptor" action of the usual impurities in germanium. An amphoteric impurity, of which gold is shown to be an example, is an element that may either donate or accept electrons in the semiconductor, depending upon the nature and amount of other impurities present, that is, upon the position of the Fermi level as determined by these impurities. Previously the acceptor action of gold in germanium had been described, and it was shown there were two acceptor levels, 0.15 and 0.55 eV above the valence band. Morton, Hahn and Schultz have found evidence of a third state which they interpret as the first acceptor level. In the present investigation, the existence of a third state is confirmed, and it is shown, with rather high degree of certainty, to be a donor level 0.05 eV above the valence band. This appears to be the first nonhydrogenic donor state yet observed in germanium. When gold is added to germanium containing third column elements in amounts less than the gold content, the carrier density remains constant, but the carriers acquire an ionization energy of 0.05 eV. Good agreement was obtained with several sources of gold. This behaviour, it appears, can be explained most simply by assuming that neutral gold atoms may give up electrons to low-lying empty states to form Au^+. The upper gold states when filled are still interpreted as Au^- and Au^{--}. A.

537.311.33

1229. CARRIER CAPTURE PROBABILITIES IN NICKEL DOPED GERMANIUM. J.F.Battey and R.M.Baum.
Phys. Rev., Vol. 100, No. 6, 1634-7 (Dec. 15, 1955).

Nickel has been diffused into germanium in order to study the carrier capture probabilities of the two nickel acceptor levels. Measurements of minority carrier lifetime as a function of temperature show that the electron capture probability of low-resistivity p-type samples is temperature-independent. The electron capture probability of high-resistivity p-type samples increases exponentially with increasing temperature, as does the hole capture probability of high-resistivity n-type samples. Possible interpretations of the results are discussed. A.

537.311.33

1230. PRESSURE DEPENDENCE OF THE RESISTIVITY, HALL COEFFICIENT, AND ENERGY GAP FOR InAs. J.H.Taylor.
Phys. Rev., Vol. 100, No. 6, 1593-5 (Dec. 15, 1955).

The effect of hydrostatic pressure on the resistivity of intrinsic n-type InAs has been measured in the range from 1 to 2000 atmospheres. The resistivity and Hall constant were found to increase exponentially with increasing pressure. Measurements of the resistivity and Hall effect yield an increase of 19 and 12% respectively for a change in pressure of 2000 atmospheres. If it is assumed the increase in resistivity is produced by an increase in the energy gap, the measurements indicate a shift of 8.8×10^{-6} eV/atmosphere. The increase in Hall constant represents a shift of 5.5×10^{-6} eV/atmosphere. A.

537.311.33

1231. THE ELECTRICAL PROPERTIES OF INDIUM ANTIMONIDE AT LOW TEMPERATURES. B.V.Rollin and A.D.Petford.
J. Electronics, Vol. 1, No. 2, 171-4 (Sept., 1955).

Reports measurements of Hall coefficient and electrical conductivity over the temperature range 1.5°K to 300°K on n- and p-type specimens of high purity. C.A.Hogarth

537.311.33

1232. NUCLEAR MAGNETIC RESONANCE IN SEMICONDUCTORS. I. EXCHANGE BROADENING IN InSb AND GaSb. R.G.Shulman, J.M.Mays and D.W.McCall.
Phys. Rev., Vol. 100, No. 2, 692-9 (Oct. 15, 1955).

Nuclear magnetic resonances have been observed for the more abundant nuclear species in the semiconductors InSb and GaSb. Broad lines have been observed and explained by a nuclear spin exchange mechanism where the interaction between the nuclei is of the form $E_{ij} = A_{ij} I_i I_j$. The exchange coupling involves the hyperfine interaction between nuclear spins and electron spins. Therefore it is very sensitive to the electron energy states in both valence and conduction bands. It is particularly sensitive to the energy surfaces far from the Fermi level and provides information about the band structure of these normally inaccessible regions. A.

537.311.33 : 538.632

1233. PHOTOINDUCED HALL EFFECT IN MgO. E.Yamaka and K.Sawamoto.
Phys. Rev., Vol. 101, No. 2, 565-6 (Jan. 15, 1956).

The signs of the charge carriers in MgO produced by light in the various absorption bands resulting from excess magnesium and oxygen were studied directly by the photo-induced Hall effect. The mobility of a hole was found to be about 2 cm^2/volt.sec. A.

537.311.33

1234. ELECTRICAL AND OPTICAL PROPERTIES OF INTERMETALLIC COMPOUNDS. IV. MAGNESIUM STANNIDE. R.F.Blunt, H.P.R.Frederikse and W.R.Hosler.
Phys. Rev., Vol. 100, No. 2, 663-6 (Oct. 15, 1955).

For Pt III, see Abstr. 949 (1955). Measurements of electrical and optical properties of this semiconductor were made over a wide temperature range. Results from conductivity and Hall effect measurements as well as optical absorption data indicate an energy gap of 0.33 eV at T = 0°K. Mobility values were found to be $\mu_e = 320$ cm^2/volt.sec (for electrons) and $\mu_p = 260$ cm^2/volt.sec (for holes) at room temperature. Both parameters are proportional to $T^{-2.2}$. Appreciable photoconductivity was observed at 85°K and at 5°K. A.

537.311.33 : 541.128

1235. ELECTRICAL CONDUCTIVITY OF HYDROCARBON CRACKING CATALYST. P.B.Weisz, C.D.Prater and K.D.Rittenhouse.
J. chem. Phys., Vol. 23, No. 10, 1965-6 (Oct., 1955).

Further investigation of the conductivities of silica–alumina catalysts show that they are related to the residual Na content, not to the alumina content, as previously suggested (Abstr. 4537/1954). The conductivities of a sample before and after base-exchange were nearly proportional to Na content: addition of Na increased conductivity; addition of K did not do so. J.Hawgood

537.311.33

1236. THE ELECTRICAL CONDUCTIVITY AT THE SURFACES OF ZINC OXIDE CRYSTALS. G.Heiland.
Z. Phys., Vol. 142, No. 4, 415-32 (1955). In German.

The state of the surface of ZnO in the temperature range 90 to 300°K is found to be modified by oxygen absorption, by irradiation with light in the lattice absorption band or by bombardment with electrons. The change in carrier concentration in the vicinity of the surface is inferred from measurements of electrical conductivity. C.A.Hogarth

537.311.33

1237. ON THE TRANSIENT BEHAVIOR OF SEMICONDUCTOR RECTIFIERS. B.R.Gossick.
J. appl. Phys., Vol. 26, No. 11, 1356-66 (Nov., 1955).

If the forward current through a p-n junction suddenly ceases, an e.m.f. appears due to nonequilibrium carrier concentrations at the junction barrier. Measurements of the barrier e.m.f have been made with a wide range of injection currents and yield current v. barrier voltage characteristic curves. The open circuit case of voltage decay across a p-n junction in the range $V \gg kT/q$ is discussed. The voltage decay is observed to be linear with time with a slope $kT/q\tau$. It follows from an analysis based on a simple model that the excess minority carrier concentrations decrease exponentially with the time constant τ. The floating emitter and collector voltages, $V_E(t)$ and $V_C(t)$, of p-n-p transistors are observed to decay like the open circuit voltage across a p-n junction, and it is noted that $V_E(t) \simeq V_C(t)$ in the range $V \gg kT/q$. The transient response of a semiconductor rectifier connected in parallel with a large external capacitance is analysed. The response calculated for large negative excursions of voltage gives a simple relation by which the saturation current may be determined. Measurements are presented and discussed. A.

537.311.33 : 621.314.7

1238. "TRANSISTOR PHYSICS". THE FORTY-SIXTH KELVIN LECTURE. W.Shockley.
Proc. Instn Elect. Engrs, Paper No. 1946, publ. Jan., 1956 (Vol. 103 B, 23-41).

537.312.5

1239. INVESTIGATIONS OF ELECTRON RELEASE. G.Nadzhakov and N.T.Kashukeev.
C.R. Acad. Bulg. Sci., Vol. 5, No. 1, 5-8 (Jan.-March, 1952). In Russian.

The influence of light of various spectral combinations upon electron release from sulphur is examined. C.G.Morgan

537.312.5

1240. PHOTOVOLTAIC EFFECT IN POLYCRYSTALLINE SULPHUR BY TRANSVERSE ILLUMINATION. G.Nadzhakov and R.Andreichin.
C.R. Acad. Bulg. Sci., Vol. 5, No. 2-3, 9-12 (April-June, Oct.-Dec., 1952). In Russian.

The photovoltaic effect for sulphur between two electrodes of different metals is investigated. Uniform illumination between electrodes gives an e.m.f. whose sign and magnitude are independent of light intensity and wavelength. It depends on the electrode metals used, and is equal to the contact p.d. between them. G.F.J.Garlick

537.312.5

1241. PHOTOCONDUCTIVITY OF CAST (DISKS OF) SULPHUR. G.Nadzhakov and N.T.Kashukeev.
C.R. Acad. Bulg. Sci., Vol. 7, No. 3, 5-8 (Oct.-Dec., 1954). In Russian.

A specimen consisting of three isolated regions of a cast disk was connected in a bridge circuit with an electrometer as detector, and the disk illuminated on one side. The out-of-balance signal was recorded photographically. Irradiation with infrared helps considerably the increase in conduction. C.A.Hogarth

537.312.5

1242. NEGATIVE PHOTOEFFECT IN CAST SULPHUR. G.Nadzhakov and N.T.Kashukeev.
C.R. Acad. Bulg. Sci., Vol. 7, No. 3, 9-12 (Oct.-Dec., 1954). In Russian.

A negative photoeffect is observed which after some time changes to a positive effect. The negative effect is affected by the wavelength of the light used, the applied voltage and the temperature. C.A.Hogarth

537.312.5

1243. BEHAVIOUR OF THE DARK CURRENT IN SECONDARY EMISSION MULTIPLIERS WITH (Ag)—Cs_2O, Cs—Ag PHOTOCATHODES. F.Eckart.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 322-30 (1955). In German.

Especially well insulated infrared photo-multipliers were tested for dark current in the temperature range +20 to +40°C. The dark current at 20°C was about 10^{-15} A/cm². The critical wavelength of the cathode was 1.17μ, corresponding with a photoelectric work function of 1.06 eV, while the work function from a Richardson plot was 0.95 eV. The surface work function, therefore, appears to be about 0.8 eV. A.H.W.Beck

537.312.5

1244. FATIGUE OF PHOTOELECTRIC EMISSION OF CAESIUM-ANTIMONIDE. K.Miyake.
J. Phys. Soc. Japan, Vol. 10, No. 10, 913-15 (Oct., 1955).

Exposure to blue-green light had only a small effect but red light caused large changes. These may be due to changes in cathode composition caused by the evaporation of small amount of Cs. A.H.W.Beck

537.312.5

1245. NON-STATIONARY PROCESSES IN PHOTOCONDUCTORS. I. SLOW RISE OF PHOTOCURRENT IN SINGLE CRYSTALS OF CdS AS A METHOD OF DEFECT LEVEL ANALYSIS. K.W.Böer and H.Vogel.
Ann. Phys. (Leipzig), Vol. 17, No. 1, 10-22 (1955). In German.

The slow rise of photocurrent for weak excitation is measured and discussed in terms of reaction kinetics. The inflection in the rise curve is attributed to the action of acceptor levels for carrier electrons. G.F.J.Garlick

537.312.5

1246. ANALYSIS OF THE DECAY OF PHOTOCONDUCTANCE IN GERMANIUM. B.H.Schultz.
Philips Res. Rep., Vol. 10, No. 5, 337-48 (Oct., 1955).

A method of analysing surface and volume effects in the re-combination of injected charge carriers is described. The influence of the capacity of a surface double layer is discussed and some of the results of measurements are given. A.

537.312.5

1247. PHOTOEFFECTS IN SEMICONDUCTORS. G.Schmidt.
Nachrichtentechnik, Vol. 5, No. 10, 468-70 (Oct., 1955). In German.

Describes the mode of operation of Ge and Si p-n junctions when irradiated with light in the range 0.4 to 1.9 microns and used as photo diodes. The characteristics of several commercial photo diodes and solar battery assemblies are summarized. C.A.Hogarth

537.312.5

1248. PHOTOCONDUCTIVITY OF SOME CYANINE DYES. R.C.Nelson.
J. Opt. Soc. Amer., Vol. 46, No. 1, 10-13 (Jan., 1956).

An examination of the properties of pinacyanole, dicyanine-A, kryptocyanine, and neocyanine indicates that the cyanine dyes constitute a distinct class of photoconductive dyes

which differ from those previously studied in being without a high density of monoenergetic traps. In consequence, their responses are fast and relatively independent of temperature. The characteristics of cells depend very sensitively on details of preparation, and the level of photoconductivity of a given cell depends more on the homogeneity of the dye film than on the properties of the dye. Evidence is given that the polymer form of pinacyanole is present in some films, and that a rate-modifying process is associated with light absorbed by it. It is concluded that the properties of these dyes are such as not to preclude the charge carrier transfer mechanism of optical sensitization. A.

537.312.5

1249. SENSITIZATION OF PHOTOCONDUCTIVITY IN CADMIUM SULFIDE. R.C.Nelson.
J. Opt. Soc. Amer., Vol. 46, No. 1, 13-16 (Jan., 1956).

The photoconductivity of cadmium sulphide in the red and near infrared can be enhanced by sensitization with cyanine dyes. There is general qualitative agreement between the results of sensitization with pinacyanole, dicyanine-A, kryptocyanine, and neocyanine, and those obtained when these dyes are used as optical sensitizers in photography, so that the two effects may be considered to be similar. Cells have been made in the form: metal electrode = dye = cadmium sulphide = metal electrode, which upon illumination show a photo-e.m.f. and steady current, the dye being positive with respect to the cadmium sulphide. A simple explanation is proposed which relates this e.m.f. to the energy difference between the conduction bands of dye and cadmium sulphide. On the basis of this picture, and assuming electron conduction in both, the conduction band of the dye must lie above that of the cadmium sulphide, and the condition for sensitization by charge carrier transfer according to the original proposal of Gurney and Mott is satisfied. A.

537.312.62

1250. ELECTRIC AND MAGNETIC BEHAVIOUR OF NIOBIUM NITRIDE (NbN) IN THE TRANSITION TO SUPERCONDUCTIVITY. A.Sellmaier.
Z. Phys., Vol. 141, No. 5, 550-65 (1955). In German.

T_c from resistance measurements was found to increase with increasing N content (15.1°K for 49.7 atomic % N, with spread of 0.2 deg. K); T_c from ballistic magnetic measurements was about 0.5 deg. K lower. The so called "paramagnetic" effect was found in the 49.7% sample but not in a less homogeneous 48.3% sample. D.Shoenberg

537.312.62

1251. EXPRESSION FOR THE MECHANICAL ENERGY OF AN ENSEMBLE OF CIRCUITS OF CONSTANT ELECTROMOTIVE FORCE AND OF IDEAL SUPERCONDUCTORS. M.Castañs.
An. Real. Soc. Españ. Fís. Quím., Vol. 51(A), No. 7-8, 189-91 (July-Aug., 1955). In Spanish.

537.312.62

1252. SUPERCONDUCTIVITY OF A CHARGED IDEAL BOSE GAS. M.R.Schafroth.
Phys. Rev., Vol. 100, No. 2, 463-75 (Oct. 15, 1955).

It is shown that an ideal gas of charged bosons exhibits the essential equlibrium features of a superconductor. The onset of Bose-Einstein condensation marks the transition temperature T_c. Below T_c a Meissner–Ochsenfeld effect is exhibited which is described in a very good approximation by London's equation. The singular nature of the condensed ideal Bose gas exhibits itself in a space dependence of the London constant λ, determined by the boundary conditions on the wave-function. It is shown that the electrostatic repulsion between the bosons compensates this effect and leads to a spatially constant λ, independently of the boundary conditions. The critical field $H_c(T)$ is determined and found to be related to the penetration depth $d(T)$ by $H_c = \hbar c/2ed^2$ (e being the boson charge). The B(H) law is different from the one usually assumed for actual superconductors. Corresponding changes occur in the thermodynamical relation. A comparison with superconducting metals is made. The main conclusion is that if superconductivity in metals is due to the concurrence of bosons, then the number of these bosons must be strongly temperature-dependent below T_c. A.

537.312.62

1253. SUPERCONDUCTIVITY AT MILLIMETRE WAVE FREQUENCIES. G.S.Blevins, W.Gordy and W.M.Fairbank.
Phys. Rev., Vol. 100, No. 4, 1215-16 (Nov. 15, 1955).

The losses in a tin waveguide were measured at frequencies from 77 to 150 kMc/s (4-2 mm), and with d.c., from 4 to 1.6°K. The d.c. transition was spread over 3.75-3.72°K; at 77 and 150 kMc/s the transition appeared at 3.72 and 3.62°K respectively. At 77 kMc/s, $h\nu = kT_c$. It is suggested that as T falls below the d.c. value of T_c, the energy gap between normal and superconducting states increases, and that superconducting behaviour only appears when the gap exceeds $h\nu$. R.G.Chambers

537.312.9 : 539.374

1254. ELECTRICAL EFFECTS ASSOCIATED WITH THE MECHANICAL DEFORMATION OF SINGLE CRYSTALS OF ALKALI HALIDES. J.E.Caffyn and T.L.Goodfellow.
Nature (London), Vol. 176, 878-9 (Nov. 5, 1955).

A change of conductivity in KI, KCl NaI and in one crystal of NaCl is reported though it is not present in NaCl from other sources. A potential effect in all crystals associated with plastic deformation is also found; its dependence on temperature and stress, and its decay with time are discussed. J.E.Caffyn

537.363

1255. ELECTROPHORETIC MEASUREMENT OF THE TRUE ZETA-POTENTIAL OF ARSENIOUS SULPHIDE SOL IN THE REGION OF SLOW COAGULATION. B.N.Ghosh and K.C.Ray.
Nature (London), Vol. 176, 1080-1 (Dec. 3, 1955).

The method of measurement based on Burton's U-tube apparatus is described. The results agree with the authors' previous conclusion that a given rate of coagulation of a colloid is characterized by a definite value of the zeta-potential independently of the valency of the counter ions used. W.Good

537.364

1256. STUDY OF ELECTROKINETIC EFFECTS USING SINUSOIDAL PRESSURE AND VOLTAGE. C.E.Cooke, Jr.
J. chem. Phys., Vol. 23, No. 12, 2299-303 (Dec., 1955).

The electrokinetic effects streaming potential, streaming current, and electro-osmotic pressure were studied by applying and measuring sinusoidal variations of hydrodynamic pressure and electrical voltage. Phenomenological relations between the effects were investigated, and an improved experimental method for measuring the electrokinetic coefficients, hence the zeta potential, was used. Saxen's law was verified within 6% at frequencies of 20, 100, and 200 c/s. The systems studied were restricted to glass-water and glass-salt solutions. The advantages and disadvantages of using sinusoidally varying quantities for electrokinetic measurements are discussed. A.

ELECTRIC DISCHARGES 537.52

537.523.3

1257. LOCALIZED CORONA DISCHARGES AT A NEGATIVE ELECTRODE. J.S.T.Looms.
Nature (London), Vol. 176, 977-8 (Nov. 19, 1955).

Describes negative corona in the form of discrete luminous tufts at wires and a jet of mercury. The implications are briefly discussed. J.D.Craggs

537.523.4

1258. ON THE U.V. RADIATION FROM ELECTRON AVALANCHES IN AIR. W. Legler.
Z. Phys., Vol. 143, No. 2, 173-90 (1955). In German.

An experimental arrangement, for studying the u.v. emission (longer than 2000 Å) from electron avalanches in air, is described. A wide-band amplifier and u.v. sensitive photomultiplier tube is used. The pd range was 20-120 mm.cm. For wavelengths between 3300 and 3600 Å, 0.4 photon was produced per electron. Cascades of avalanches were observed, and oscillograms are shown. J.D.Craggs

537.523.4

1259. AN INVESTIGATION OF THE TIME-VARYING DEVELOPMENT PROCESSES IN SPARKS, OPTICAL ABSORPTION THEREIN, AND SUBSEQUENT AFTERGLOWS.
J.van Calker.
Z. Naturforsch., Vol.10a, No. 9-10, 697-706 (1955). In German.

Describes a stroboscopic method of studying temporal variations of spark channel appearance etc. Absorption spectra, for example of sparks against a continuous background, are shown. These are discussed in terms of vaporization processes at the electrodes etc. Photographs of complete channels, and the absorption spectra etc., are given for times varying up to about 1-2 millisec at intervals of about $1\text{-}2 \times 10^{-4}$ sec. Details of phenomena involving erosion of fragments from electrodes at the later stages, with Cu electrodes, are given. J.D.Craggs

537.523.4 : 621.3.015.54

1260. THE ELECTRIC DISCHARGE IN HEAVY-CURRENT SPARKS. I. EXPERIMENTAL RESULTS. G.Glaser and D.Sautter.
Z. Phys., Vol. 143, No. 1, 44-61 (1955). In German.

Experimental results are given to show how the oscillatory nature of heavy-current (approx. 100 A to 10 kA) impulse discharges depends on dimensions, inductance and diffusion. The results are in the form of graphs which show the variation of voltage, current, power, resistance and radius of the discharge with time and the voltage–current curves for unrestricted discharges in argon and hydrogen and for capillary discharges in xenon. J.Dutton (R)

537.523.4 : 621.3.015.54

1261. THE ELECTRIC DISCHARGE IN HEAVY-CURRENT SPARKS. II. NUMERICAL TREATMENT OF THE SPARK DISCHARGE. G.Glaser.
Z. Phys., Vol. 143, No. 1, 62-76 (1955). In German.

Approximate theoretical expressions are derived for current, voltage and power (as functions of the time, discharge resistance and total resistance capacity and inductance of the circuit) in heavy-current sparks similar to those investigated experimentally (see preceding abstract). Values for the spark resistance are obtained from consideration of the experimental results. J.Dutton (R)

537.523.5

1262. ON THE BEHAVIOUR OF INTERRUPTED HIGH-CURRENT ARCS. R.Wienecke.
Z. Phys., Vol. 143, No. 1, 118-27 (1955). In German.

Describes a circuit for the rapid switching-off of arcs, at currents of about 200 A. Photographs were taken, with time resolution, of the glowing arc columns in air, argon and nitrogen. In some cases afterglows lasting some 3 millisec were observed and series of photographs are shown. Afterglow mechanisms are discussed. J.D.Craggs

537.523.5

1263. ON THE THEORY OF ANODE FALLS. II. THE POSSIBILITY AND LIMITS OF FIELD IONIZATION.
K.H.Höcker and W.Bez.
Z. Naturforsch., Vol. 10a, No. 9-10, 706-14 (1955). In German.

A continuation of previous work (Abstr. 5649/1954) on the anode fall region of arc discharges. In the present paper ionization by electrons in the anode fall is discussed. For this to be applicable the fall voltage must be greater than the appropriate ionization potential. In other conditions, it is suggested, thermal ionization is operative, and the respective ranges of applicability (w.r.t. arc current) of these two mechanisms are treated. J.D.Craggs

537.523.5

1264. ON THE THEORY OF ANODE FALLS. III. THE EQUIPOTENTIAL SURFACES IN FRONT OF THE ANODE.
W.Bez and K.H.Höcker.
Z. Naturforsch., Vol. 10a, No. 9-10, 714-17 (1955). In German.

A further discussion (see preceding abstract) of the anode-fall region of arcs. Here the relation between the shapes of equipotential surfaces in front of the anode and the current density and radial temperature variations of the anode is discussed. The formation of anode spots at higher temperatures is also dealt with. J.D.Craggs

537.523.5

1265. ON THE "VELOCITY FIELD" OF HIGH-CURRENT CARBON ARCS. R.Wienecke.
Z.Phys., Vol. 143, No. 1, 128-40 (1955). In German.

Describes two methods for studying the mass flow in and near hot arc channels, using currents of about 200 A. An optical method is described, and another technique in which the movement of incandescent carbon particles is followed. Time resolved photography, using times of about 20 microsec is involved. Detailed figures, showing flow lines, are given. J.D.Craggs

537.523.5

1266. A QUANTITATIVE INVESTIGATION OF THE LENARD "HOLLOW FLAME". A.Eberhagen.
Z. Phys., Vol. 143, No. 3, 312-30 (1955). In German.

In certain (arc) discharges the excitation of, e.g., alkali metal vapours is more intense at the periphery of the discharge than on the axis. The importance of radial temperature variations etc. is discussed. Experimental data are given, for a wide variety of arc conditions, particularly for Sr vapour in the column, on radial variations of temperature, and ion, atom and electron densities. Arc currents of about 10 A were used; other electrical data are given. The results are discussed in detail. J.D.Craggs

537.525

1267. ON EXTRACTION OF IONS FROM PLASMA-LIKE MEDIA. W.Fischer and W.Walcher.
Z. Naturforsch., Vol. 10a, No. 11, 857-63 (1955). In Germa

An arc struck in silver vapour evaporated from a carbon oven is used as a source of an ion stream. The ions are extracted through a diaphragm resembling a Pierce electrode The plasma on the source side is investigated with a cylindrical Langmuir probe. Conditions regarding density, potential mean free path, are very non-uniform. Nevertheless the authors infer from their measurement that plasma temperatu of the order of 13 000°K are reached, a quarter to half the electron temperature. From the observed constant current a a function of the voltage of the extraction electrode the author conclude that the ions are supplied by diffusion. From this and simple probe theory these temperatures are deduced. Conditions of the discharge on the side opposite to the source are described as that of a pseudoplasma. It is pointed out that here the $U^{\frac{3}{2}}$ law which is observed may arise from the interplay of such factors as current division between the elec trodes and the width of the beam and thus does not necessaril represent simple space charge behaviour. H.Mot

537.525

1268. THE REDUCTION OF THE POTENTIAL LIMIT DIFFERENCES FOR ELECTRONEGATIVE VAPOURS AND GASES IN ELECTRODELESS CONTINUOUS DISCHARGES. S.R.Mohanty.
J. Chim. phys., Vol. 52, No. 11-12, 815-17 (Nov.-Dec., 1955). In French.

Briefly describes certain observed characteristics of high-voltage electrodeless a.c. corona discharges in Siemens ozonizer tubes containing, e.g., iodine vapour. J.D.Craggs

537.525 : 538.639

1269. PARTICLE TRANSPORT, ELECTRIC CURRENTS, AND PRESSURE BALANCE IN A MAGNETICALLY IMMOBILIZED PLASMA. P.Stehle.
Phys. Rev., Vol. 100, No. 2, 443 (Oct. 15, 1955).

The expression for the pressure gradient in a magnetically immobilized plasma, $\nabla p = -(1/8\pi)\nabla(B^2)$ is derived without detailed study of particle orbits, while still showing the various effects which appear in a detailed treatment. (See also Abstr. 4693/1955). A.

537.525.4

1270. ELECTRICAL MICRODISCHARGES IN DYNAMIC VACUA. R.Arnal.
Ann. Phys. (Paris), Vol. 10, 830-73 (Sept.-Oct., 1955). In French.

Describes in great detail the properties of pre-breakdown discharges in continuously pumped apparatus. Special reference is made to electron-microscopes etc., where h.t. voltages are encountered. The mechanism invoked as a possible explanation of the discharges involves showers of particles (electrons, H^- ions and positive ions of H and H_2) as in the work of Trump and van de Graaff. The importance of occluded or absorbed gas in, and surface layers on, the electrodes is stressed. Hence the work is not applicable to high-vacuum sealed-off tubes. The apparatus and experimental results (including mass spectra of the shower ions) are described at length. J.D.Craggs

537.525.5

1271. LANGMUIR'S PARADOX. D.Gabor, E.A.Ash and D.Dracott.
Nature (London), Vol. 176, 916-19 (Nov. 12, 1955).

Describes an investigation to determine the mechanism responsible for the existence of a Maxwellian distribution of the electron velocities in gas discharges, at pressures too low for normal collisions to play a significant role. Experiments with a low-pressure, mercury arc discharge, using an electron-beam probe, revealed the presence of oscillations in the sheath, at a frequency of 100-200 Mc/s (considerably lower than the plasma frequency), and of an intensity sufficient to account for the observed stability of the Maxwellian distribution. The magnitude of the disturbance revealed by the electron probe decreased with increasing pressure, but it is not clear to what extent this indicates a decrease in the oscillation amplitude, or a decrease in its spatial coherence. E.A.Ash

537.525.8

1272. POTENTIAL CONDITIONS IN A DECAYING PLASMA. G.Mierdel.
Wiss. Z. Tech. Hochsch. Dresden, Vol. 4, No. 4, 611-18 (1954-55). In German.

A theoretical and experimental investigation of the temporal variation of potentials, measured by probes, in a decaying low-pressure discharge plasma with currents between 0.5 and 8 A. C.G.Morgan

537.525.8

1273. ON THE ELECTRON EMISSION FROM CATHODE SURFACES FOLLOWING A GLOW DISCHARGE. R. Röhler.
Naturwissenschaften, Vol. 42, No. 16, 459-60 (1955). In German.

Describes measurements of striking times, following the application of a dead-time pulse, in glow discharges from which values of the delayed cathode emission may be obtained; the effect is discussed briefly in terms of surface layers. Noble gases do not show the effect but admission of 0.1% O_2 or N_2(10-20 mm total pressure of argon) produces it. The effect of halogen layers is mentioned. J.D.Craggs

537.525.8

1274. ON THE NATURE OF SILENT ELECTRIC DISCHARGE. K.Honda and Y.Naito.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1007-11 (Nov., 1955).

The current pulses produced by the silent electric discharge of an ozonizer tube were measured by a cathode-ray oscillograph as well as by a milliammeter with filter and rectifier, and from comparison of these two series of results, the following conclusions were attained. (1) The wave form of each pulse consists of two parts, the peak rush of current at the head and the smooth tail following this. There is a reason to infer that the peak rush is due to electrons and the smooth part to positive ions produced by electrons in the space. (2) The measured average value of the rushing current is just one half of the total current, hence the electron current must be equal to the ion current. (3) If the discharge is assumed to die away at the stage of electron avalanche, the calculation does not agree with observation. On the other hand, if the discharge is assumed to develop at least up to the streamer stage, the observed results can be explained satisfactorily. A.

537.525.8

1275. AMPLIFICATION OF 1 cm WAVES IN THE HELIUM NEGATIVE GLOW. Z.Geller and W.Low.
Nature (London), Vol. 176, 1021-2 (Nov. 26, 1955).

The attenuation of 1.25 cm waves in the negative glow of a 1-3 mm Hg pressure helium glow was measured. Near the beginning (i.e. the cathode side) of the negative flow an amplification of up to about 1 db/cm was observed. This effect is briefly discussed. J.D.Craggs

537.525.8

1276. OSCILLOGRAPHIC STUDIES OF JOSHI EFFECT AND SECONDARY PROCESSES IN A LOW FREQUENCY ELECTRIC DISCHARGE. B.D.Khosla and N.A.Ramaiah.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1067-77 (Dec., 1955).

Low-frequency (50 c/s) electric discharge in iodine vapour with glass electrodes was investigated by a cathode-ray oscillograph. The r.m.s. value of the conductivity was contributed chiefly by two types of pulses, the electron avalanches of which were produced by secondary electrons originating from the cathode and the gas phase. The secondary process concerned with the liberation of electrons from the cathode due to positive ionic bombardment thereon appeared significant for the onset of the discharge under investigation. The maintenance of the discharge seemed primarily due to photo-ionization of the gas particles in the homogeneous phase. External radiation inhibited the secondary emission from the cathode to give negative Joshi effect, and enhanced that from the gas phase to produce positive Joshi effect; it did not, however, alter the field gradient in the system. A.

537.525.92

1277. ON THE SPACE CHARGE AFFECTED BY THE MAGNETIC FIELD. Y.Yasuoka.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1102-9 (Dec., 1955).

The characteristic phenomena of the dense space charge of electrons bound by a strong magnetic field are described. Electrons in the outermost sheath of the electron cloud are considered to be scattered by mutual interaction and to have excess energies. Calculation based on this view is in good agreement with experiment. It is especially noteworthy that

when the anode voltage is raised to the proper value, this sheath is captured by the anode and certain unique oscillations are observed to occur. The frequencies of these oscillations very nearly coincide with those obtained from Langmuir's formula of plasma oscillation. A.

X-RAYS 537.531

537.531 : 535.33

1278. STUDIES OF THE "TECHNICAL" CONTINUOUS SPECTRUM OF X-RAYS. II. A UNIVERSAL FORMULA FOR THE TOTAL MASS ABSORPTION COEFFICIENT, μ/ρ, FOR X-RAYS AND GAMMA-RAYS. H.Tellez-Plasencia.
J. Phys. Radium, Vol. 16, No. 8-9, 709-12 (Aug.-Sept., 1955). In French.

For Pt I, see Abstr. 9283 (1954). Experimental data on absorption are collected, and empirical formulae are derived for the total mass absorption coefficient (i.e. photoelectric absorption + scattering losses). It is claimed that these formulae fit the data over a wide wavelength range, and are easy to compute. A.R.Stokes

537.531 : 778.33 : 621.386.1

1279. AN X-RAY TUBE FOR MICRORADIOGRAPHY. B.Combée.
Philips tech. Rev., Vol. 17, No. 2, 45-6 (Aug., 1955).

A 5 kV tube, 8 cm long with 0.05 mm Be window is described. Resolution achieved with contact radiography and subsequent enlargement is 0.5 to 1 micron. F.T.Farmer

537.531.08 : 537.533.9

1280. ACTION LAW OF FAST ELECTRON RAYS. R.Glocker.
Z. Phys., Vol. 143, No. 2, 191-204 (1955). In German.

An extension of previous work (Abstr. 3820, 4579-80/1954, 3815/1955) in which a formula for the calculation of the energy transfer of fast electron rays in different layers, allowing for polarization correction, is derived, and also for the energy distribution in the secondary electron spectrum. Measurements and calculations for an air ionization chamber, an air equivalent counter and a highly dilute $FeSO_4$ solution for electron energies of 15 MeV are given and the theoretical and experimental connection of dosimetry for fast electrons and X-rays is considered. C.G.Morgan

537.531.8

1281. THE RÖNTGEN-K-FLUORESCENCE YIELD OF NEON, ARGON, KRYPTON AND XENON. J.Heintze.
Z. Phys., Vol. 143, No. 2, 153-67 (1955). In German.

This was measured using a proportional counter, with the element under investigation as the counter gas. The results were: Ne, $w_K = 0.018 \pm 0.004$; A, $w_K = 0.129 \pm 0.01$; Kr, $w_K = 0.66 \pm 0.02$; Xe, $w_K = 0.88 \pm 0.03$. The results are compared with those of other workers and with the theoretical predictions. J.Hughes

CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533.2

1282. THE ELECTRON EMISSION FROM THE SURFACE OF SOLID BODIES AFTER MECHANICAL WORKING AND IRRADIATION. H.Nassenstein.
Z. Naturforsch., Vol. 10a, No. 12, 944-53 (1955). In German.

The experimental evidence is briefly reviewed. The existing theories: (1) the emission is due to energy liberated in recrystallization after the surface is disordered (Kramers); (2) the emission is due to chemical changes, e.g. oxidation, (Haxel, Houtermans and Seeger) are critically discussed. The author proposes a theory similar to the theory of phosphorescence and describes some new experiments in support. Possible uses of the phenomenon, especially in surface studies are discussed. A.H.W.Beck

537.533.2

1283. ELECTRON EMISSION FROM A LATTICE STEP ON CLEAN TUNGSTEN. J.K.Trolan, J.P.Barbour, E.E.Martin and W.P.Dyke.
Phys. Rev., Vol. 100, No. 6, 1646-9 (Dec. 15, 1955).

Electron emission has been observed from the edges of the outermost atom layer of a (110) crystal face of clean tungsten. A bright ring appears in the (110) area of the emission pattern on a pulsed T-F emission electron microscope when current densities exceeding 10^7 A/cm^2 are drawn. When the emitter is maintained at an elevated temperature, T equal to or greater than 1700°K, the ring decreases in radius and eventually disappears. This is followed by the appearance of a new ring at the periphery of the dark (110) region, making possible the observation of a sequence of such collapsing rings. An experiment is reported which associates the ring collapse with the loss of an atom layer from the cathode tip, causing a change in its length, which is equal on the average to the interplanar spacing of the (110) crystal direction. This association proves that electron emission is observed from a lattice step and provides a convenient means for the study of the corresponding processes by which cathode material is transported. A.

537.533.3

1284. STATIC AND DYNAMIC ELECTRON OPTICS. AN ACCOUNT OF FOCUSING IN LENS, DEFLECTOR AND ACCELERATOR. P.A.Sturrock.
Cambridge: The University Press (1955), x + 240 pp. (Cambridge Monographs on Mechanics and Applied Mathematics).

In the first part (static), units convenient for electron-optical calculations are defined; a variational equation is derived and applied to the paraxial focusing of magnetic and electrostatic lenses. Classical geometrical optics are then reviewed (Hamilton's point characteristic function, Lagrange and Poincaré invariants) and interpreted in terms of electron optics. A "perturbation characteristic function" is introduced to take account of small departures from simple focusing, and adapted to a form convenient for determining aberrations in instruments with curved or straight axes. This is used to determine the chromatic and third-order geometrical aberrations, and aberrations due to manufacturing inaccuracies of rotationally symmetrical systems; it is also applied to systems with mirror symmetry, particularly β-ray and mass spectrographs and cathode-ray tube deflectors.

In the second part (dynamic), adiabatic invariants and matrices are used in addition to the foregoing theory to determine the motion of particles in the synchrotron, linear accelerator, and strong-focusing synchrotron. Phase acceptance, tolerances and stability conditions are discussed.
A.E.I.Research Laboratory

537.533.3

1285. APPLICATION OF THE "KNIFE-EDGE" METHOD TO THE ESTIMATION OF ABERRATIONS OF DEFLECTED ELECTRON BEAMS. H.Grümm.
Optik, Vol. 12, No. 12, 544-53 (1955). In German.

Expressions are given for the shapes of the shadows of certain test objects (straight edges, wires) when the electrons forming them pass through simple deflecting fields. It is shown that by measuring the shadows, the "coma" and "astigmatism" of the deflecting system can be determined. Diagrams of typical shadows are given.
A.E.I. Research Laboratory

537.533.3 : 535.327.3

1286. NEW QUANTITATIVE PROCEDURES FOR THE ELECTRON-OPTICAL SHADOW METHOD. C.Schwink.
Optik, Vol. 12, No. 11, 481-96 (1955). In German.

A previous paper (Abstr. 3536/1954) was concerned with developing further the schlieren method of Marton for detecting extremely localized magnetic fields. The present paper gives a further analysis of the method. A new experimental method is described giving increased sensitivity. This is done by placing a wire between lens and specimen in addition to the one which is normally placed between specimen and viewing screen. A.E.I. Research Laboratory

537.533.35

1287. A HIGH TRANSMISSION BETA-RAY SPECTROMETER OF THE DOUBLE FOCUSING TYPE. E.Arbman and N.Svartholm.
Ark. Fys., Vol. 10, Paper 1, 1-18 (1955).

A general purpose beta-ray spectrometer of the double focusing type is described and preliminary results are given. The instrument has a mean radius of 18.0 cm and can focus electrons of energy up to 5 MeV. The transmission is variable from 4% of a sphere down to ½% of a sphere according to the resolution required. Facilities are provided for automatic spectrum plotting. D.R.Chick

537.533.74

1288. THE ABSOLUTE MEASUREMENT OF DIFFERENTIAL CROSS SECTIONS FOR THE NUCLEAR SCATTERING OF LOW ENERGY RELATIVISTIC ELECTRONS.
K.R.Chapman, E.Matsukawa, P.H.Rose and E.A.Stewardson.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 928-9 (Oct., 1955).

The incident electron beam was produced in an electrostatic generator and after scattering by a thin foil detected in a Faraday cylinder, this method of measurement being very insensitive to X-ray background. Curves are given for the scattering cross-sections of Al over the angular range 100^0-150^0 at energies of 0.4 and 0.5 MeV, the experimental results agreeing well with the theoretical predictions. J.Hughes

537.533.74

1289. COULOMB SCATTERING OF ELECTRONS AT VERY SMALL ANGLES. M.J.Moravcsik.
Phys. Rev., Vol. 100, No. 4, 1009-12 (Nov. 15, 1955).

Electrostatic scattering of highly relativistic electrons at very small angles is discussed. The Hartree wave-function is used to calculate the screening effects for the smallest angles. The calculations are facilitated by a theorem which states that, in the Born approximation for elastic scattering by any physical central potential, the total cross-section in the relativistic limit is independent of energy. Both the "elastic" (nuclear) and "inelastic" (electronic) contributions to the scattering are investigated. It is found that at very small angles the inelastic differential cross-section exceeds by many times the elastic differential cross-section. Numerical calculations were carried out for scattering by nitrogen atoms, where the total cross-section of the scattering by atomic electrons is 3.6 times the total cross-section due to screened nuclear scattering. A.

537.533.74

1290. ANGULAR DEPENDENCE OF THE CHARACTERISTIC ENERGY LOSS OF ELECTRONS PASSING THROUGH METAL FOILS. R.A.Ferrell.
Phys. Rev., Vol. 101, No. 2, 554-63 (Jan. 15, 1956).

The Bohm–Pines electron plasma theory is employed to give a theoretical interpretation of some experimental results of Marton et al. on the scattering of 20 keV electrons by a thin gold foil. General criteria are presented which can in principle select in any given case between the alternative mechanisms of collective excitation or one-electron excitation. For the general case of collective excitation the scattering law is derived and used in a numerical analysis of the experimental data. Agreement with the Bohm–Pines theory is satisfactory. A.

537.533.75 : 537.534.75

1291. PENETRATION OF ELECTRONS AND IONS IN ALUMINUM. J.R.Young.
J. appl. Phys., Vol. 27, No. 1, 1-4 (Jan., 1956).

The depth of penetration of 0.5 to 11 keV electrons and 1 to 25 keV H^+, H_2^+ and He^+ ions in aluminium was measured. It was found that the Thompson–Whiddington law for electrons does not hold for electrons having energies less than 10 keV. The practical range-energy relation obtained for electrons in aluminium was found to be $R = KE^{1.3}$, where K is 0.042 if E is expressed in keV and R in microns. The practical range-energy relation for light ions in aluminium was found to be $R = KE^{0.83}$ where K = 0.020 for H^+, K = 0.21 for He^+ and K = 0.015 for H_2^+ if E is expressed in keV and R in microns. Results are compared with those obtained by previous observers. A.

537.533.75 : 539.232

1292. TRANSPARENCY OF 1000 TO 3000 A THICK ALUMINIUM OXIDE FILMS TO ELECTRONS OF ENERGY BELOW 16 keV. O.Hoffmann.
Z. Phys., Vol. 143, No. 2, 147-52 (1955). In German.

The films, prepared by anodic oxidation of Al, were 95 to 100% transparent to 16 keV electrons, the transparency gradually decreased for lower energies. An energy-range relation was obtained. The ranges in alumina films are slightly greater than in collodion and formvar. J.Franks

537.533.8

1293. INDUSTRIAL UTILIZATION OF BREMSSTRAHLUNG. P.Lévêque and P.Martinelli.
J. Phys. Radium, Vol. 16, No. 8-9, 729-30 (Aug.-Sept., 1955). In French.

A few observations are reported on the spectra and intensities of bremsstrahlung obtainable from (Sr^{90}, Y^{90}) and P^{32} beta-ray sources, used with Al or Pb absorbers. A method of measuring the thickness of thin (0-70 micron) coatings of gold on brass is described briefly. J.J.Wilkins

537.533.8

1294. EFFECT OF ELECTRON BOMBARDMENT ON SECONDARY AND PHOTOELECTRIC EMISSION OF CAESIUM-ANTIMONIDE. K.Miyake.
J. Phys. Soc. Japan, Vol. 10, No. 10, 912-13 (Oct., 1955).

The influence of electron bombardment on δ max was measured for bombarding times up to 25 hours. For photoelectrically active surfaces an initial increase in δ max was followed by a decline to about 70% of the initial value in 10 hours and a stable period of 15 hours. The photoelectric yield was simultaneously measured and showed the same trend. A.H.W.Beck

537.533.8

1295. MEASUREMENT OF THE HIGH-ENERGY END OF THE BREMSSTRAHLUNG SPECTRUM. D.C.Hagerman and K.M.Crowe.
Phys. Rev., Vol. 100, No. 3, 869-73 (Nov. 1, 1955).

Results of a diffenential measurement of the upper 6% of the bremsstrahlung photon spectrum produced by 500 ±25 MeV electrons agree with the Bethe–Heitler formula within the combined experimental errors of approximately 25%. The measurement was made by running a collimated beam of 10^3 electrons per pulse through a diffusion cloud-chamber and observing the electrons degraded in energy by the production of a gamma-ray. Observation of electron–electron scattering events provided a normalization in the centre of the energy region investigated. A total of 330 events was observed. The performance of a diffusion cloud-chamber under these conditions is discussed. A.

537 533.8

1296. BREMSSTRAHLUNG SPECTRUM FROM THE INTERNAL TARGET OF A 22-MeV BETATRON. E.V.Weinstock and J.Halpern.
Phys. Rev., Vol. 100, No. 5, 1293-8 (Dec. 1, 1955).

The intensity and energy distribution of the bremsstrahlung photons produced in a betatron operating at 22 MeV have been determined by measurement of the energy spectrum of photoprotons ejected from deuterium. The protons were detected using a 0.15 cm thick NaI crystal followed by a 100-channel pulse-height analyser. The photon beam was highly collimated in the forward direction. If one assumes the energy dependence of the cross-section for the photodisintegration of deuterium as given by Hulthén, the computed bremsstrahlung energy distribution is in excellent agreement with the theoretical thin-target spectrum. The observed total intensity is that indicated by monitoring using an "R" thimble in 3.9 cm of Lucite. A.

537.534

1297. PROTON LINEAR ACCELERATORS FOR NUCLEAR RESEARCH AND THE A.E.R.E. 600 MeV PROJECT. T.G.Pickavance.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 1, 413-22 (1955).

The important advantage of the linear accelerator lies in its ability to provide intense beams of the primary accelerated particles. This makes it possible to obtain useful yields of secondary particles such as π -mesons in well-collimated beams with small energy spread. Alternating gradient focusing appears to be the best method in high-energy proton linear accelerators and this principle will be adopted in the Harwell machine, which is intended to produce a mean beam current of 1 microamp of 600 MeV protons with a 1% duty cycle and 50 Mc/s pulse duration. Some details of the tank constructions and the r.f. sources are discussed. L.R.Shepherd

537.534

1298. OBSERVATION OF ANTIPROTONS. O.Chamberlain, E.Segrè, C.Wiegand and T.Ypsilantis.
Phys. Rev., Vol. 100, No. 3, 947-50 (Nov. 1, 1955).

Sixty antiprotons produced by the bevatron beam of protons on a copper target have been detected. Particles with the correct momentum were selected by magnets. A Cherenkov counter selected particles in the narrow velocity interval $0.75 < v/c < 0.78$. In order to separate the antiprotons off from the high π^--background, a further velocity determination by means of a time-of-flight measurement with two scintillation counters was made. Three scintillation counters and the Cherenkov counter were required to count in coincidence. A further guarding Cherenkov counter recorded particles with $v/c > 0.79$ so that these could be excluded.
A rough determination of the dependence of the antiproton production cross-section on the energy of the intital beam has been made. G.E.Brown

537.534

1299. A SIMPLE LENS SYSTEM FOR VARIABLE-VOLTAGE VAN DE GRAAFF GENERATORS. W.Dähnick, H.Neuert and U.Timm.
Z. Naturforsch., Vol. 10a, No. 8, 603-5 (Aug., 1955). In German.

Describes the use of a multi-electrode lens in the injector system, which enables the ions to be focused, using considerably lower voltages than required with a two-element lens. This reduces the difficulty of generating the required potentials in the high-voltage electrode of the generator, and also makes the focal properties of the system less sensitive to changes in the total accelerator voltage. In the example considered the ion beam could be focused on to the target, for generator potentials between 0.5 and 1.5 MV, by varying the ion-source extractor voltage between 2.4 and 6 kV. E.A.Ash

537.534.3

1300. THE ASTIGMATISM OF THE TOROIDAL CONDENSER. H.Ewald and H.Liebl.
Z. Naturforsch., Vol. 10a, No. 11, 872-6 (1955). In German.

The ion orbits in the vicinity of the median orbit of a toroidal condenser are investigated. It turns out that this can be done by means of formulae developed by Herzog (Z. Phys., Vol. 89, 447, 1934) for the special case of a cylindrical condenser. The spherical condenser treated by Svartholm (Abstr. 8777/1950) and others is another special case. Aberrations are not investigated but the main image properties are tabulated. Experimental verifications show good agreement.

537.534.3

1301. THE IMPROVEMENT AND THE PRESENT CAPABILITIES OF THE DOUBLE FOCUSING MASS SPECTROGRAPH. R.Bieri, F.Everling and J.Mattauch.
Z. Naturforsch., Vol. 10a, No. 9-10, 659-67 (1955). In German.

A diagram of the spectrograph is given and the improvements in the mechanical adjustments and the stability of the field detailed. Some typical doublet spectra are given in which, for favourable cases, a resolving power of 100 000 for mass determination is achieved. J.Hughes

537.534.3

1302. INFLUENCE OF STRAY MAGNETIC FIELDS ON THE POSITION AND QUALITY OF IMAGES IN MASS SPECTROGRAPHS AND SPECTROMETERS. R.F.K.Herzog.
Z. Naturforsch., Vol. 10a, No. 11, 887-93 (1955). In German.

The influence of the fringing field at the edge of a magnet is described by two numbers, one measuring the location of the edge of a sharply delimited 'substitute' field, defined as one which produces the same angular deflection in a beam, and the other measuring the remaining shift of the true emerging ray with respect to the parallel one emerging from the substitute field. The resulting shift in the image position can be reduced, though not eliminated, by careful shielding. The construction of the image when the corrections are taken into account is described in the general case of oblique incidence. For the Mattauch–Herzog spectrograph the corrections can be reduced by adjusting the position of the energy-interval slit. W.J.Swiatecki

537.534.3

1303. PRELIMINARY REPORT ON A LARGE MASS SPECTROGRAPH NEWLY CONSTRUCTED AT OSAKA UNIVERSITY. K.Ogata and H.Matsuda.
Z. Naturforsch., Vol. 10a, No. 11, 843-50 (1955).

This double-focusing spectrograph has a uniform magnetic field of $\pi/3$ sector type and $\sqrt{2}(\pi/3)$ cylindrical electric field. The radius of the central ion beam in magnetic fields is 1200 mm, and in electric field 1093 mm. From the preliminary experiment, the dispersion coefficient was estimated to be about 9 cm for 1% mass difference and the maximum resolving power about 500 000. In the preliminary determination of N_2^{14}–$C^{12}O^{16}$ doublet mass difference, a value of 112.441 (10^{-4} a.m.u.) was obtained with the present condition. A.

537.534.3

1304. THE IMAGE PROPERTIES OF MAGNETIC SECTOR FIELDS INCLUDING THE FRINGING FIELD. L.A.König and H.Hintenberger.
Z. Naturforsch., Vol. 10a, No. 11, 877-86 (1955). In German.

An abbreviated account of a dissertation by L.A.König (Mainz 1955, D 77) is given. First the fringing fields at the boundaries of sector magnets of several types are investigated experimentally. Formulae for magnification, velocity and direction focusing are given with reference to H.Ewald and H.Hintenberger, Methoden und Anwendungen der Massenspektroskopie, Weinheim/ Bergstrasse: Verlag Chemie, (1953). The optical properties with fringing fields (investigated by N.D.Coggeshall, Abstr. 352/1948), are related to

hose of ideal sector fields and extensive formulae are given. The changes due to the fringing field are calculated for the mass spectrograph of Bainbridge and two other types. They depend strongly on magnet dimensions. For typical magnets of double focusing spectrographs the exact formulae of the paper differ only by a few % from the calculations done by means of equivalent homogeneous sector fields. This method of accounting for fringing fields leads to much greater errors with other types of magnets. H.Motz

537.534.3

1305. MASS SPECTROMETERS WITH SECOND-ORDER DOUBLE FOCUSING. H.Hintenberger, H.Wende and L.A.König.
Z. Naturforsch., Vol. 10a, No. 8, 605-12 (Aug., 1955). In German.

Derives the conditions for which second-order correction of directional and chromatic errors can be achieved, for one given charge to mass ratio, while retaining first-order correction of these errors for all charge to mass ratios. It is concluded that by a suitable choice of the ratio of the radius of curvature of the trajectory in the electric field to that in the magnetic field, and of the separation between the two fields, the required second-order correction can be obtained; these conditions are compatible with those which ensure first-order correction, only if the two deflections are in the same sense. The conditions are presented in a series of graphs, and some numerical examples are calculated. E.A.Ash

537.534.3

1306. THE NEWTONIAN IMAGE EQUATION FOR A SECTOR MAGNET, TAKING THE FRINGING FIELD INTO ACCOUNT. L.A.König.
Z. Naturforsch., Vol. 10a, No. 8, 652-4 (Aug., 1955). In German.

The trajectory is divided into the uniform and fringing field regions. Equations are set up, which do not assume that the effect of the fringing field is small, and which remain valid when image and object are immersed in the field. Useful results can be obtained when the fringing field is a function of a single spatial coordinate. Results are presented for the case of cylindrical and sector magnets. E.A.Ash

537.534.3

1307. TIME-OF-FLIGHT MASS SPECTROMETER WITH IMPROVED RESOLUTION. W.C.Wiley and I.H.McLaren.
Rev. sci. Instrum., Vol. 26, No. 12, 1150-7 (Dec., 1955).

A new type of ion gun is described which greatly improves the resolution of a nonmagnetic time-of-flight mass spectrometer. The focusing action of this gun is discussed and analysed mathematically. The validity of the analysis and the practicability of the gun are demonstrated by the spectra obtained. The spectrometer is capable of measuring the relative abundance of adjacent masses well beyond 100 atomic mass units. A.

537.534.74

1308. PROTON-PROTON POLARIZATION AT 170 MeV. D.Fischer and J.Baldwin.
Phys. Rev., Vol. 100, No. 5, 1445-7 (Dec. 1, 1955).

The polarization was measured and the data fitted to a curve of the form $P = \sin\theta\cos\theta(\alpha + \beta\cos^2\theta)$, yielding $\alpha = 0.31 \pm 0.09$ and $\beta = 0.30 \pm 0.14$. A comparison is made with results obtained at other energies. A.

537.534.74 : 539.18

1309. MEAN-VALUE CALCULATIONS FOR SPATIAL MULTIPLE SCATTERING. J.S.Goldberg, H.S.Snyder and W.T.Scott.
Phys. Rev., Vol. 100, No. 4, 1013-14 (Nov. 15, 1955).

Calculation of five types of mean values for the spatial (three-dimensional) multiple-scattering theory of Molière and Snyder-Scott is reported: arithmetic mean, half-width, 1/e width, median, and a "Gaussian" width fitted to the zero-angle scattering intensity. The results are expressed in terms of simple interpolation formulae accurate to one per cent. A.

537.534.75

1310. RELATIVE STOPPING POWER OF VARIOUS METALS FOR 20-MeV PROTONS. C.P.Sonett and K.R.MacKenzie.
Phys. Rev., Vol. 100, No. 2, 734-7 (Oct. 15, 1955).

The stopping powers of Ni, Cu, Cb, Pd, Ag, Cd, In, Ta, Pt, Au and Th, relative to Al were measured using the 20.6 MeV external proton beam of the University of California cyclotron. The measurements were made with sufficient precision so that a graph of $\ln Z$ v. stopping power/electron relative to Al showed some fluctuations from a linear relationship. For Th the value differs by 2.6% in the direction found by Kelly and by Teasdale. The results are compared with the data compiled by Lindhard and Scharff. A.

537.534.9

1311. EFFECT OF ALPHA-PARTICLES ON GASEOUS HYDROGEN AND DEUTERIUM. S.Lormeau-Loustau.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1758-60 (Dec. 14, 1955). In French.

The variation with pressure of the intensity of the ultraviolet radiation emitted by hydrogen and deuterium under alpha-particle bombardment does not follow the same rules as in the case of argon, neon, air, nitrogen and oxygen (see Abstr. 2449/1949). At a given pressure, the emission from D_2 is 1.7 times more intense than that from H_2. C.B.Allsopp

DISCHARGE TUBES. COUNTERS 537.54

537.542

1312. POINTS OF VIEW REGARDING THE CONSTRUCTION OF A POSITIVE ION SOURCE. W.Dällenbach.
Z. Naturforsch., Vol. 10a, No. 9-10, 803-5 (1955). In German.

Experiments by W.Dällenbach and E.Gerecke, Elektrotechnische Zeitschrift, Vol. 57, 937 (1936), on mercury discharges are recalled in which a plasma had to pass through a constriction between anode and cathode. It was observed that there exists for each pressure level a limiting current. Below it the potential drop remains constant, above it the voltage rises very rapidly and the discharge becomes unstable. This is explained in terms of a double layer situated in the constricting diaphragm. The limiting current is reached when the dynamic pressure of the ion stream leaving the diaphragm becomes comparable to the static vapour pressure of the discharge between cathode and constriction. It is proposed that a proton gun giving 2.3 mA through a diaphragm of 0.01 cm^2 cross-section might be constructed according to a principle suggested by the above experiments. It would be advantageous to inject the hydrogen as a supersonic jet. H.Motz

537.542

1313. THE ION SOURCE OF THE AMSTERDAM ISOTOPE SEPARATOR. J.Kistemaker, P.K.Rol, J.Schütten and C.de Vries.
Z. Naturforsch., Vol. 10a, No. 11, 850-6 (1955).

The ion source has as essential parts: (1) the discharge chamber with filament, (2) the furnace for the production of the gas (vapour), (3) the heated screens and the labyrinths, (4) the acceleration- and lens electrode, (5) the power supplies and cooling systems, (6) the arc stabilization. These parts are shown and explained. Especially a survey has been given of the five types of breakdown which can disturb a smooth ion production. A.

537.542

1314. THE DISCHARGE MECHANISM IN ARGON-FILLED PROPORTIONAL COUNTERS. K.Schütt.
Z. Phys., Vol. 143, No. 4, 489-512 (1955). In German.

Discusses in detail the mechanism of pulse formation in proportional counters with cylindrical geometry filled with A/N_2 and A/O_2 mixtures. Oscillograms of pulses are given. Multiplication factors are plotted against tube voltage for various gas fillings. The interpretation of pulse shapes in terms of basic discharge parameters etc. is given in detail.
J.D.Craggs

537.542 : 539.185

1315. A PROPORTIONAL COUNTER WITH BERYLLIUM WALLS FOR THE DETECTION OF FAST NEUTRONS. Y.Kœchlin.
J. Phys. Radium, Vol. 16, No. 8-9, 707-8 (Aug.-Sept., 1955). In French.

A brief description is given of a proportional counter which is effectively sensitive only to fast neutrons. A comparison between different chamber wall materials is also provided.
A.J.Egginton

537.542

1316. IMPROVED ALPHA AIR PROPORTIONAL COUNTER. F.J.Lynch and J.B.Baumgardner.
Rev. sci. Instrum., Vol. 26, No. 12, 1134-7 (Dec., 1955).

The limitations of alpha counters using air in the proportional amplification region were investigated with a view toward a better design that would provide improved performance and reliability. A new detector is described which incorporates a shielded guard-ring insulator assembly that provides freedom from insulator failure at high humidities. It is believed that spurious pulses also arise from the effect of humidity on the conductivity of foreign particles adhering to the anode wires. Reducing the relative humidity (r.h.) by the use of a small heater which maintains the detector 20° F above room temperature prevents this type of failure and provides reliable operation at 98% r.h. The associated amplifier and discriminator were designed to detect the slow components of the ionization pulses associated with the transit time of negative oxygen ions. The resulting efficiency is 39% of the total disintegrations, with a plateau of over 150 V having a slope of less than 4% per 100 V. A.

537.542 : 539.185.08

1317. HELIUM-3 FILLED PROPORTIONAL COUNTER FOR NEUTRON SPECTROSCOPY. R.Batchelor, R.Aves and T.H.R.Skyrme.
Rev. sci. Instrum., Vol. 26, No. 11, 1037-48 (Nov., 1955).

The neutron transformation of He^3 has been applied to neutron spectroscopy in the medium energy range in order to overcome the disadvantages of previous methods which have usually been based on neutron scattering. By observing the pulse-height distribution when a proportional counter filled with He^3, krypton, and carbon dioxide is irradiated with neutrons, the spectrum can be obtained. Details of the counter construction and vacuum equipment for filling the counter are described. In the range of energy from thermal to 1 MeV the spread (relative standard deviation of a peak) is about 3% and the wall effect agrees with theoretical predictions. The pulse height varies linearly with energy and some evidence suggesting that the mean energy required to produce an ion pair in krypton for He^3 nuclei is about 6% greater than that for protons is presented. Since the neutron reaction cross-section of He^3, as a function of energy, is required to evaluate neutron spectra from observed distributions, it has been remeasured in the range 120 keV to 1 MeV with greater accuracy than previously. A.

537.542

1318. ON THE EFFICIENCY OF DETECTION OF PHOTONS IN THE MIDDLE OF LIQUID SCINTILLATORS. E.Beretta and G.Poiani.
Nuovo Cimento (Ser. 10), Vol. 2, No. 2, 362-4 (Aug., 1955). In Italian.

The self absorption of light within a solution of terphenyl in xylene was studied by investigating the efficiency of detection of Co^{60} gamma-rays as a function of the length of the liquid column. The influence of the physical nature of the walls of the enclosure was also studied and the results are presented graphically. J.Hughes

537.542

1319. CHARACTERISTICS OF THE OPTICAL SYSTEM OF A SCINTILLATOR. Y.Koechlin.
J. Phys. Radium, Vol. 16, No. 11, 849-53 (Nov., 1955).

The efficiency of optical coupling between scintillator and photomultiplier is discussed in terms of the covering material for the scintillator, its form and position at which the scintillations are produced. G.F.J.Garlick

537.542

1320. LARGE SCINTILLATORS AS THRESHOLD DETECTORS FOR HIGH-ENERGY PROCESSES. J.J.Thresher, C.P.van Zyl, R.G.P.Voss and R.Wilson.
Rev. sci. Instrum., Vol. 26, No. 12, 1186-91 (Dec., 1955).

The design is described of several liquid organic scintillation counters which have been used to detect 100 MeV neutrons and gamma-rays with the exclusion of lower energy particles and quanta. The neutron counter efficiency is a few per cent and is nondirectional, properties not possessed by a more conventional counter telescope system. The gamma-ray counter has an efficiency of about 50%, with a line width of about 10%. Particular problems arise in the use of these counters; counting rate stability is difficult to achieve; the maximum counting rate is limited by the pileup of individual pulses due to their finite width. These problems are discussed in detail and some solutions mentioned. A

537.542

1321. THEORY OF COUNTING RANDOM EVENTS. M.Feix
J. Phys. Radium, Vol. 16, No. 8-9, 719-27 (Aug.-Sept., 1955). In French.

An investigation into the effect of a "dead-time", (a) operating from the time an event is registered on the counter, (b) operating from the time an event occurs (whether during the dead time from a previous event or not). There is also a study of signal/noise ratio and a bibliography with 29 references. N.L.Johnson

537.542

1322. STATISTICAL THEORY OF DELAYED-COINCIDENCE EXPERIMENTS. Z.Bay, V.P.Henri and H.Kanner.
Phys. Rev., Vol. 100, No. 4, 1197-208 (Nov. 15, 1955).

The consistent use of a general statistical theory makes possible the elimination of ambiguities and of idealizing assumptions from the interpretation of delayed-coincidence experiments. Introduction of the concept of the "total coincidence counting rate" (which can be determined experimentally) makes possible the definition of resolving time, thereby eliminating discrepancies between earlier definitions; it also provides means for relating the coincidence efficiencies directly to the number of source events. The effect of random time lags on coincidence curves is calculated and experimental methods for the determination of time lags are derived. The statistical errors in the determination of moments of a coincidence curve are calculated and outlined in detail for first moment investigations. It is shown that: (1) the best choice of the resolving time is a (experimentally measurable) weighted r.m.s. of all time delays present in the measurement; (2) using the best choice of the resolving time the standard error of the centroid obtained by successive measurements of the points of a coincidence curve, is approximately twice the least theoretical standard error (that could be obtained for the total time of observation); (3) the moment method can be applied generally for

the determination of mean time delays; other methods, while applicable with some restrictions, can lead to similar or greater statistical errors. A.

537.542 : 621.374.5

1323. MAGNETOSTRICTIVE DELAY LINES. A.Tarabella and R.Bibron.
Onde élect., Vol. 35, 682-6 (July, 1955). In French.

Deals with applications in nuclear physics, especially to the problem of selecting, counting and storing pulses within a given amplitude range, the number of counting channels numbers between 4 and 100. A.H.W.Beck (R)

IONIZATION. THERMIONICS 537.56/58

537.561

1324. ON THE FLOATING PROBE METHOD FOR THE MEASUREMENT OF IONIZED GAS. K.Yamamoto and T.Okuda.
J. Phys. Soc. Japan, Vol. 11, No. 1, 57-68 (Jan., 1956).

Several problems connected with the floating probe method are discussed and solved. Analysing the variation of ion current due to sheath expansion, the authors obtain the criterion for applicability of the usual double-probe method and also the general expression available for the estimation of electron temperature. From the relation between probe characteristic and electron energy distribution, a floating triple method is newly proposed. This method is useful for the measuring of energy distribution in electrodeless or h.f. discharges. By special use of the floating double or triple probe, the measurement of potential distribution in such a quasi-plasma as an ion sheath, and the transition region between plasma and ion sheath, can be attained. As one example, the floating potential becomes measurable. The floating, or insulating, potential is discussed in detail and expression is given showing good agreement with measured values. A.

537.562

1325. PHOTOIONIZATION EFFICIENCIES AND CROSS SECTIONS IN N_2O AND NO. W.C.Walker and G.L.Weissler.
J. chem. Phys., Vol. 23, No. 10, 1962 (Oct., 1955).

Absorption and ionization measurements within the ionization continuum were obtained for the purified commercial tank gases. For N_2O an ionization onset was found at 965 ± 5 A in agreement with the known ionization potential of 12.6 - 12.9 eV. Absorption and ionization cross-sections are presented in a diagram and show a pressure variation for some lines. For NO an ionization onset corresponding to 9.2 ± 0.03 eV in agreement with known values is obtained. The cross-sections were found to be independent of pressure for the region studied. W.Good

537.563

1326. IONIZATION AND DISSOCIATION PROCESSES IN THE VAPORS OF LITHIUM CHLORIDE, SODIUM CHLORIDE AND POTASSIUM CHLORIDE. R.M.Hobson.
J. chem. Phys., Vol. 23, No. 12, 2463-4 (Dec., 1955).

The positive and negative atomic and molecular ions formed by electron bombardment of LiCl vapour were observed with a mass spectrometer. Some preliminary data are also given for NaCl and KCl. The results are briefly discussed, particularly with reference to ions (e.g. Li_2Cl^+, $Li_3Cl_2^+$, Li_2Cl^- and $LiCl_2^-$) formed by clustering. J.D.Craggs

537.564

1327. MECHANISM OF UNIFORM FIELD BREAKDOWN IN HYDROGEN. A.Wilkes, W.Hopwood and N.J.Peacock.
Nature (London), Vol. 176, 837-8 (Oct. 29, 1955).

Results of measurements on the growth of pre-breakdown ionization currents in hydrogen for E/p between 15 and 22 V/cm.mm Hg are given, and shown to be consistent with the Townsend theory of ionization growth and breakdown. The values of the primary ionization coefficients obtained are compared graphically with experimental and theoretical values obtained previously by other workers. J.Dutton

537.564

1328. GROWTH OF PRE-BREAKDOWN IONIZATION CURRENTS IN HYDROGEN. R.W.Crompton, J.Dutton and S.C.Haydon.
Nature (London), Vol. 176, 1079 (Dec. 3, 1955).

Experimental results are given to show that for values of pd_S (p is the pressure, d_S the sparking distance) up to about 640 mm Hg.cm, the growth of ionization currents in hydrogen follows the well known Townsend equation. Values of the primary ionization coefficient are given for values of E/p between 16 and 25 V/cm.mm Hg. J.Dutton

537.564

1329. IONIZATION BY ALPHA PARTICLES IN MIXTURES OF GASES. W.P.Jesse and J.Sadauskis.
Phys. Rev., Vol. 100, No. 6, 1755-62 (Dec. 15, 1955).

The presence of minute impurities greatly increase the ionization produced by Po alpha particles in helium. Systematic studies of this effect show an increase in ionization up to 40% for approximately 0.1% of argon. Similar results have been obtained with CO_2, Kr, Xe, H_2, N_2 and C_2H_4 as the contaminant. Preliminary experiments with mercury vapour in helium confirm the large effect already reported by others. A similar increase in ionization in pure argon is obtained by the addition of C_2H_2 or C_2H_4. These increases in ionization seem to be caused by the production of ions, when metastable atoms in the parent gas undergo collisions with molecules of the impurity. In mixtures of H_2, N_2 or A with helium, the excess in ionization is observed to decrease by a few per cent as the pressure of the gas mixture is increased from 48 to 110 cm of mercury. For no other contaminant gases tested thus far in helium is such a pressure change in ionization observed. A.

537.564 : 537.534.3

1330. IONIZATION IN A MASS SPECTROMETER BY MONOENERGETIC ELECTRONS. R.E.Fox, W.M.Hickam, D.J.Grove and T.Kjeldaas, Jr.
Rev. sci. Instrum., Vol. 26, No. 12, 1101-7 (Dec., 1955).

Over the last few years, a method has been developed for obtaining ionization probability curves with essentially monoenergetic electrons. A retarding potential is applied to the electron beam to yield an energy distribution with a sharp low-energy limit. By varying the retarding potential slightly, a new low-energy limit of the distribution can be selected. The difference in the ionization produced in the two cases is ionization by those electrons with a small energy spread selected from the original distribution. By pulsing the electrons and ions, it is possible to eliminate the adverse effect of the ion-drawout field on the electron energy. With this retarding potential difference (RPD) method, a detailed analysis of ionization probability curves is possible. A full description of this method is given with a discussion of its advantages and limitations. The mass spectrometer used in this series of studies is described, particular attention being given to a description of the ion source. The various electrodes of the electron beam slit system are described in terms of their influence on the electron energy, and on the shapes of ionization probability curves. A.

537.566

1331. EFFECT OF PROBE SIZE ON ION CONCENTRATION MEASUREMENTS IN FLAMES. I.R.King and H.F.Calcote.
J. chem. Phys., Vol. 23, No. 11, 2203-4 (Nov., 1955).

Describes how measurements of ion concentrations may be in error, in certain flames, (e.g. alkali-loaded propane—air flames) by a factor of about 10^3, if the effect of finite probe

PA

size is neglected. Corrections for the latter may be made as described in the note. J.D.Craggs

537.568

1332. ELECTRON LOSS PROCESS IN THE HYDROGEN AFTERGLOW. K.B.Persson and S.C.Brown.
Phys. Rev., Vol. 100, No. 2, 729-33 (Oct. 15, 1955).

Electron loss processes in the afterglow of very pure hydrogen have been studied by the microwave technique. The conclusion is drawn that within the error of the experiment, no electron–ion recombination is observed, and that high-mode diffusion is very evident. By properly accounting for the high diffusion modes, the results are given as D_ap = 700 ± 50 cm^3.mm Hg.sec^{-1} with the electron–ion recombination less than 3×10^{-8} cm^{-3}.sec^{-1}. A.

537.581

1333. SCHOTTKY EFFECT FOR SrO FILMS ON MOLYBDENUM. G.A.Haas and E.A.Coomes.
Phys. Rev., Vol. 100, No. 2, 640-1 (Oct. 15, 1955).

The Schottky effect and the periodic deviations about the Schottky line have been simultaneously investigated for thin films of SrO on molybdenum. The experimentally determined Schottky slope is in good agreement with the theoretical value for deposits less than a monolayer; but becomes larger than theory for more than a monolayer. The periodic deviations obtained for a clean molybdenum surface wash out when as little as 1/60 monolayer of SrO is deposited on the surface. The implication is that the electron reflection coefficient near a Mo–SrO surface cannot be associated with the simple μ reflection found for clean metals. A.

537.583

1334. MEASUREMENTS OF RETARDING POTENTIAL ON THE HOLLOW CATHODE. A.W.Bright and J.S.Thorp.
Nature (London), Vol. 176, 1079-80 (Dec. 3, 1955).

The measurements tend to support the view that the electron temperature of the hollow cathode does not vary greatly from that of a conventional oxide cathode at the same temperature. Current densities of the same order were obtainable from hollow and filled-in cathodes, which indicates that high current densities do not appear to be a property of the electron gas inside the hollow cathode. C.G.Morgan

COSMIC RAYS 537.591

537.591

1335. INTERNATIONAL COSMIC RAY CONFERENCE.
Nature (London), Vol. 176, 1105-6 (Dec. 10, 1955).

Brief report of the Mexico meeting (Sept. 5-13, 1955) of the Cosmic Ray Commission of the International Union of Pure and Applied Physics.

537.591.1

1336. ON CHERENKOV RADIATION OF COSMIC PARTICLES IN THE EARTH'S ATMOSPHERE. A.P.Polikarov.
C.R. Acad. Bulg. Sci., Vol. 7, No. 2, 29-32 (April-June and July-Sept., 1954). In Russian.

The energy-dependence of Cherenkov particles in cosmic rays on the atmospheric height is established. On that ground the existence of such particles has been proved and an approximate value for the intensity of the Cherenkov radiation (about 10^4 photons per cm^2 sec) obtained. A.

537.591.1

1337. LECTURES ON THE ORIGIN OF COSMIC RAYS. B.Rossi.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 1, 275-335 (1955).

These give an account first of what is known about the primary cosmic ray mass and energy spectrum, and the geomagnetic effects of cosmic rays. Some relevant astronomical data are given which are also fundamental to galactic theories of the origin of cosmic rays. The c.r. fluctuations and their correlation with solar phenomena are discussed with particular emphasis on large intensity increases associated with solar flares and calculations of impact zones. Further chapters deal with the small increases associated with solar flares, solar diurnal variations, trapping mechanisms operating in the vicinity of the sun, as well as with magnetic storm effects and with the 27-day recurring variations. It is assumed that the majority of the observed c.r. comes from sources in the galaxy, but different from the sun. An estimate of the mean free path of c.r. particles before escape from the galaxy is given, and the importance of the question of the abundance of Li, Be and B in the primary radiation is stressed with reference to the mean life of c.r. particles. The observed isotropy of c.r. is regarded as substantiating evidence of a galactic magnetic field. Trapping mechanisms are discussed, particularly the Diffusion Model, and this, too, in conjunction with an acceleration mechanism of the Fermi kind. It is pointed out that such theories must explain the behaviour of the c.r. spectrum at the low energy end as well as the possibly total absence of electrons and photons in the primary radiation. Different models predict different kinds of anisotropy; experimentally, not enough is known about the shape of the spectrum and the existence of possible anisotropies at high energies. E.W.Kellermann

537.591.1

1338. COSMIC-RAY EXPERIMENTS WITH A PROTON VELOCITY SELECTOR. K.W.Ogilvie.
Canad. J. Phys., Vol. 33, No. 12, 746-56 (Dec., 1955).

Experiments with a selector of slow heavy cosmic-ray particles are described. The pressure coefficient of protons at sea level in the momentum region 700 to 1100 MeV/c is found to be $0.64 \pm 0.08\%$ per mb. Points are obtained on the differential momentum spectrum of protons at sea level between 650 and 1250 MeV/c, in agreement with the results of Mylroi and Wilson. This spectrum is discussed in connection with the experiments of Filthüth between 200 and 900 MeV/c. A.

537.591.15

1339. ON THE "HIGHER MAXIMA" IN THE SHOWER TRANSITION CURVE. H.Faissner and W.Bothe.
Z. Naturforsch., Vol. 10a, No. 9-10, 794 (1955). In German.

The arrangement used by Thurn and Bothe (Abstr. 1927/1952), who found other maxima besides the Rossi maximum in the transition curve, was repeated with additional electronic safeguards to ensure effective decoupling. Neither the 2nd nor the 3rd maximum was found with this arrangement, nor did the introduction of further counter trays in the lead affect this result. E.W.Kellermann

537.591.15

1340. INVESTIGATIONS OF COSMIC-RAY SHOWERS WITH A COUNTER-CONTROLLED CLOUD CHAMBER.
J.Jänecke, W.Bothe and K.H.Lauterjung.
Z. Naturforsch., Vol. 10a, No. 9-10, 794-5 (1955). In German.

Cloud chamber photographs taken under lead absorbers did not show any events which could be interpreted as due to showers connected with maxima other than the Rossi maximum in the transition curve. E.W.Kellermann

537.591.15

1341. ON THE COSMIC-RAY SHOWERS OBSERVED UNDER INCREASING LEAD ABSORBERS. B.Schimmer and K.H. Lauterjung.
Z. Naturforsch., Vol. 10a, No. 9-10, 795 (1955). In German

The experiments by Thurn and Bothe (Abstr. 1927/1952) and by Schmeiser and Bothe (1938) have been repeated with altered coincidence circuits. The transition curves show no second maximum. E.W.Kellermann

537.591.15

1342. ON THE PENETRATING SHOWERS PRODUCED IN PARAFFIN AND GRAPHITE. I.Miura, T.Matano, Y.Toyoda and T.Murayama.
Progr. theor. Phys., Vol. 13, No. 1, 115-17 (Jan., 1955).

A cloud chamber containing plates of paraffin and graphite was used to obtain information on the nature of the showers produced in hydrogen. The conclusion is reached that multiple production of mesons can arise in the collision of a nucleon with a proton in hydrogen. A.J.Egginton

537.591.15

1343. CALCULATIONS ON THE CASCADE THEORY OF SHOWERS. S.K.Chakrabarty and M.R.Gupta.
Phys. Rev., Vol. 101, No. 2, 813-19 (Jan. 15, 1956).

The solution of the cascade equations, obtained previously by Bhabha and Chakrabarty, is rearranged in a form suitable for numerical calculations. Although the solution is still in the form of an infinite series, the first term alone gives practically the entire contribution to the number of particles in a shower for all values of the energy of the shower particles. The results are compared with the values given previously by Bhabha and Chakrabarty and also by Snyder. The defects in the analysis of Snyder are discussed. Values of $N(E, t)$, the total number of particles in a shower having energies greater than E, are obtained for different values of E, t and E_0. By the evaluation of a single integral it is now possible to obtain the values of $N(E, t)$ for any value of E in the entire range (O, E_0), and also the nature of the energy spectrum of the shower electrons at different depths. Asymptotic values to which $P(E, t)$ and $N(E, t)$ merge, when E tends to zero and infinity, are derived from the general expression. It is shown that the values of $N_0(t) + N_2(t)$, derived previously by Bhabha and Chakrabarty, are a fair approximation to the value of $N(E, t)$ if $E = 2mc^2$. A.

537.591.2

1344. DETERMINATION OF THE INTENSITIES OF LOW-Z COMPONENTS OF THE PRIMARY COSMIC RADIATION AT $\lambda = 41^0$ USING A ČERENKOV DETECTOR. W.R.Webber and F.B.McDonald.
Phys. Rev., Vol. 100, No. 5, 1460-7 (Dec. 1, 1955).

A measurement of the intensities of the low-Z components of the primary cosmic radiation was made in the upper atmosphere at a depth of 13 g/cm^2 by means of a "Skyhook" balloon flown at $\lambda = 41.5^0$. The measuring instrument consisted of a thin (3.0 g/cm^2) Cherenkov detector placed within the solid angle of a Geiger counter telescope. A Cherenkov detector was used because of its unique discrimination against slow particles. A system of guard and shower counters and circuits was included to identify side showers and background events occurring in the detector. A vertical intensity of 82 ± 9 alpha-particles/m^2. steradian. sec, at the top of the atmosphere was obtained, based on 374 counts attributed to alpha-particles. Data obtained as the balloon rose to altitude gave a value of 43 ± 8 g/cm^2 for the apparent absorption mean free path of alpha-particles in air. An upper limit was set on the intensity of primary protons at this depth. In addition, a small number of counts that could be attributed to particles with Z between 3 and 5 were obtained and are discussed. A.

537.591.8 : 523.51

1345. COSMIC RADIATION EFFECTS IN METEORITES. P.Reasbeck and K.I.Mayne.
Nature (London), Vol. 176, 733-4 (Oct. 15, 1955).

Measurements are reported on the neon content of iron meteorites. The quantities observed agree well with the theory that they are residual nuclei left after evaporation due to cosmic radiation. A.J.Egginton

538.11 : 539.11

1346. STUDY OF THE MAGNETISM OF A GAS OF ELECTRONS IN TWO DIMENSIONS. A.Pacault and A.Marchand.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 489-91 (Aug. 1, 1955). In French.

The thermal variation of the magnetic susceptibility of carbon black and of graphite is calculated using a theoretical relationship for the free electrons contained in a two-dimensional network. Agreement with experimental results is good. G.I.W.Llewelyn

538.114

1347. THE QUANTUM THEORY OF FERROMAGNETISM. S.V.Vonsovskiĭ, K.B.Vlasov and E.A.Turov
Zh. éksper. teor. Fiz., Vol. 29, No. 1 (7), 37-50 (1955). In Russian.

The magnetic interaction of the electrons of a ferromagnetic is represented on a multi-electron quantum-mechanical crystal model. The energy spectrum of the system at low temperatures is calculated. Consideration of the magnetic interaction terms in the original Hamiltonian of the system leads to the emergence of energy components of quasi-classic magnetic type as well as terms of the type of anistropic (magnetic) exchange. The latter may be important, e.g. in calculating relaxation phenomena in ferromagnetics and antiferromagnetics. Electrical Research Association

538.114

1348. ANISOTROPY OF THE PERMEABILITY AND MAGNETO-CALORIC EFFECT IN ANTIFERROMAGNETICS. K.B.Vlasov.
Izv. Akad. Nauk, SSSR, Ser. fiz., Vol. 19, No. 4, 481-8 (1955). In Russian.

The macroscopically steady magnetic state of an antiferromagnetic is determined by a minimum thermodynamic potential, e.g. minimum free energy. To calculate the free energy associated with the magnetic state of an antiferromagnetic it is necessary to consider its energy in an external magnetic field, the energy of interaction of the elementary magnetic moments and that of the electrostatic exchange interaction. A range of field strengths is considered where external field energy is much less than exchange energy, but possibly greater than energy of interaction.
Electrical Research Association

538.114

1349. MAGNETIC ANISOTROPY AND VAN VLECK'S RELATION FOR ANTIFERROMAGNETICS. K.F.Niessen.
Philips Res. Rep., Vol. 10, No. 2, 131-40 (April, 1955).

For the influence of magnetic anisotropy on the susceptibility of antiferromagnetics a formula is derived which is more general than that given by Nagamiya (Abstr. 1110/1952), since anisotropy coefficients are supposed to be different for the two kinds of magnetic spins and also a small difference in the spin moments is taken into account. A corresponding extension of Van Vleck's relation between the powder susceptibilities at 0^0 K and at the Curie temperature is given. A.

538.114

1350. RESONANCE FIELDS OF A SYSTEM WITH MAGNETIC SUBLATTICES. (FERRIMAGNETIC RESONANCE). B.Dreyfus.
C.R. Acad. Sci. (Paris), Vol. 241, No. 6, 552-4 (Aug. 8, 1955). In French.

Derives relations for the resonance field H in terms of the characteristics of the two sublattices. The conditions for zero and imaginary values of H are derived, and it is shown that H can never become infinite. For earlier calculations see Abstr. 592 (1954). E. P. Wohlfarth

538.114

1351. THE SOLUTIONS OF THE FERRIMAGNETIC RESONANCE EQUATIONS. B.Dreyfus.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1270-2 (Nov. 7, 1955). In French.

The four solutions of the resonance equation previously derived (preceding abstract) are considered in more detail, and it is shown that there are in general two resonance peaks, one of which is of very low intensity and not usually observable. E.P.Wohlfarth

538.114

1352. THE ORIGIN OF FERROMAGNETISM OF THE TRANSITION METALS. J.Friedel.
J. Phys. Radium, Vol. 16, No. 11, 829-38 (Nov., 1955). In French.

Ferromagnetism is interpreted on the basis of the band picture, the bandwidth being small and the exchange interaction intra-atomic. The absence of ferromagnetism in Pd and Pt is interpreted as arising from strong spin–orbit coupling. The Curie points of alloys are also discussed. E.P.Wohlfarth

538.114

1353. INFLUENCE OF CRYSTALLINE ELECTRIC FIELDS ON ANTIFERROMAGNETIC TRANSITIONS. L.D.Roberts, R.B.Murray and J.W.T.Dabbs.
Phys. Rev., Vol. 100, No. 4, 1100-3 (Nov. 15, 1955).

The Van Vleck two-sublattice treatment of antiferromagnetism predicts theoretically an equality between the transition temperature T_C and the Weiss constant Δ, a prediction which is not usually borne out by experiment. In this paper, through the use of the effective spin Hamiltonian, the treatment of Van Vleck is extended to include a crystalline electric field term. It is shown that Δ and T_C depend on this in an important way, especially at low temperatures, and it is further shown that this term may contribute to the observed inequality of Δ and T_C. A.

538.114 : 536.764

1354. MAGNETIC SECOND-ORDER TRANSITIONS.
K.J.Tauer and R.J.Weiss.
Phys. Rev., Vol. 100, No. 4, 1223-4 (Nov. 15, 1955).

The following correlations were derived from published thermal data for α-Fe and several antiferromagnetic substances: (1) $H/RT_C \simeq 1$, (2) $S/R\ln(2s+1) \simeq 1$, (3) $H/S = T_C/\ln(2s+1) = AZ$, where H is the magnetic enthalpy, S the magnetic entropy, T_C the Curie temperature, s the number of unpaired electrons, Z the coordination number and A a constant equal to about 113. E.P.Wohlfarth

538.114 : 539.11

1355. CONSIDERATIONS ON DOUBLE EXCHANGE.
P.W.Anderson and H.Hasegawa.
Phys. Rev., Vol. 100, No. 2, 675-81 (Oct. 15, 1955).

Zener has suggested a type of interaction between the spins of magnetic ions which he named "double exchange". This occurs indirectly by means of spin-coupling to mobile electrons which travel from one ion to the next. This interaction was calculated for a pair of ions with general spin S and with general transfer integral, b, and internal exchange integral J. One result is that while the states of large total spin have both the highest and lowest energies, their average energy is the same as for the states of low total spin. This should be applicable in the high-temperature expansion of the susceptibility, and if it is, indicates that the high-temperature Curie–Weiss constant θ should be zero, and $1/\chi$ v. T a curved line. This is surprising in view of the fact that the manganites, in which double exchange has been presumed to be the interaction mechanism, obey a fairly good Curie–Weiss law. The results can be approximated rather well by a simple semiclassical model in which the spins of the ion cores are treated classically. This model is capable of rather easy extension to the problem of the whole crystal, but the resulting mathematical problem is not easily solved except in special circumstances, e.g., periodic disturbances (spin waves). A.

538.2 : 538 652

1356. QUANTUM THEORY OF MAGNETOSTRICTION.
A.A.Gusev.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 181-92 (1955). In Russian.

A consistent quantum-mechanical theory of the magnetostriction of hexagonal monocrystals, based on Bogolyubov and Tyablikov's theory of the polar model of a metal, considering magnetic and magneto-elastic interaction of the electrons in the lattice, is presented. This shows that magnetostriction is due to the magnetic interaction of the electrons and yields the temperature relation of the magnetostriction constants, the energy spectrum at low temperatures and the free energy of the crystal. Electrical Research Association

538.22

1357. A SIMPLE METHOD OF OBSERVING ELEMENTARY MAGNETIC DOMAINS USING DRY POWDER. W.Andrä and E.Schwabe.
Ann. Phys. (Leipzig), Vol. 17, No. 1, 55-6 (1955). In German.

The iron oxide powder used to study the domain structure of cobalt was produced by oxidation of carbonyl iron. The pattern is compared with that obtained by using a colloidal suspension, which gives better resolution. E.P.Wohlfarth

538.22

1358. THEORY OF THE MAGNETIC SUSCEPTIBILITY OF GRAPHITE. J.E.Hove.
Phys. Rev., Vol. 100, No. 2, 645-9 (Oct. 15, 1955).

The theory of the magnetic susceptibility of graphite is presented in terms of a three-dimensional Wallace electron energy-band structure. The experimentally observed variation with temperature is explained in a satisfactory manner, provided the interplane resonance integral occurring in the band approximation is given a value of about 0.5 eV. This is about five times larger than the previously used estimate and implies that a two-dimensional band approximation may be invalid in many cases. The in-plane resonance integral is obtained by fitting the variation, with electron concentration, of the electrical resistivity of a graphite–bisulphate residue compound. In this way a value of 1.63 eV for this integral is obtained. It might be noted that these values enabled a better fit of the resistivity over the entire range of bisulphatization than could be obtained by a two-dimensional theory. On the other hand, the value thus obtained for the actual magnitude of the susceptibility is lower than that observed by a factor of about 40. The (room-temperature) variation of the susceptibility of bromine graphite is then analysed on the basis of the above theory, using the indicated values of the constants. In this way, a value is obtained for the percentage of the bromine which is ionized. This is found to be weakly dependent on the amount of bromine, varying between 18% at 0.3 atomic per cent bromine to 13% at 0.8 atomic per cent bromine. The experimental value has been found to vary slightly around 18%. This agreement is very good and indicates that the theory is valid in explaining relative variations of the susceptibility, even though there is difficulty in predicting the absolute magnitude. The latter is the only serious discrepancy found in the present work and has not yet been explained. A.

538.22 : 538.615

1359. DIPOLAR MAGNETIC RESONANCE AT 3.245 AND 12.67 Mc/s WITH OPTICALLY ORIENTED SODIUM ATOMS.
E.Geneux, B.Vincenz, G.Béné and R.Extermann.
Helv. phys. Acta, Vol. 28, No. 4, 333-5 (1955). In French.

Using Kastler's orientation technique, resonances at 3.245 Mc/s and 4.6 gauss and at 12.67 Mc/s and 18 gauss, were observed in Na vapour. Fine structure was just visible at the higher frequency but saturation is easy at these low frequencies. The photomultiplier detector is protected from

the effect of the magnetic field by opposing Helmholtz coils.
D.H.Whiffen

538.22 : 541.67

MAGNETIC SUSCEPTIBILITIES OF SOME URANIUM (IV) COMPOUNDS. See Abstr. 775.

538.221/.222

1360. ON THE PARA- AND ANTIFERROMAGNETIC STATES OF COBALT FLUORIDE. T.Nakamura and H.Taketa.
Progr. theor. Phys., Vol. 13, No. 2, 129-47 (Feb., 1955).

The magnetic behaviour of CoF_2 in the solid state can be satisfactorily described in terms of Pryce's effective Hamiltonian with $\Lambda_x = 1.34 \times 10^{-3}$, $\Lambda_y = 1.73 \times 10^{-3}$ and $\Lambda_z = 0.19 \times 10^{-3} (cm^{-1})^{-1}$, where the c-axis is taken as x-axis and a line connecting Co^{++} and its first neighbours F^- as z-axis. In the paramagnetic regions $\chi_{\parallel}$ is of the ordinary type, obeying the Curie-Weiss law approximately. $\chi_{\perp}$, however, is similar to the paramagnetic susceptibility of ferrimagnetics. These predictions are in good agreement with the experimental results of Stout and Matarrese. $\chi_{\parallel}$ has a finite value of the order 10^{-2} e.m.u. even at 0°K because of the fact that the magnetic field parallel to the c-axis induces a virtual transition from the lowest energy level to a higher one separated by about 10^2 cm^{-1}. The value of $\chi_{\perp}$ at 0°K is also computed. A.

538.221

1361. FERROMAGNETIC RESONANCE ABSORPTION IN $BaFe_{12}O_{19}$, A HIGHLY ANISOTROPIC CRYSTAL. J.Smit and H.G.Beljers.
Philips Res. Rep., Vol. 10, No. 2, 113-30 (April, 1955).

The ferromagnetic resonance absorption was measured at 24000 Mc/s for a single crystal of hexagonal $BaFe_{12}O_{19}$. The resonance conditions are severely influenced by the crystalline anisotropy and, for fields too small for saturation, also by the Weiss-domain structure. The theory predicts, for a varying magnetic field perpendicular to the hexagonal axis, at most three absorption peaks, which have been observed at elevated temperatures. The gyroscopic splitting factor g and the anisotropy field are evaluated. The g-factor has the spin-only value. The crystalline anisotropy is suggested to be caused by dipole-dipole interaction. A.

538.221

1362. FERROMAGNETIC RESONANCE IN MAGNESIUM-MANGANESE ALUMINIUM FERRITE BETWEEN 160 AND 1900 Mc. H. Suhl, L. G. Van Uitert and J. L. Davis.
J. appl. Phys., Vol. 26, No. 9, 1180-2 (Sept., 1955).

Reports results of measurements on a disk-shaped ferrite specimen with composition Mg : Mn : Al : Fe = 1.00 : 0.11 : 0.65 : 1.27, which has a relatively low resonance frequency. This is found to be a linear function of the applied field strength (100-900 oersted) but with an anomalously low intercept, which is interpreted in terms of the incomplete saturation of the individual crystal grains. Line profiles were found to be asymmetrical, being wider on the low-field side of resonance. E. P. Wohlfarth

538.221

1363. FERROMAGNETIC RESONANCE IN NICKEL AND IN SOME OF ITS ALLOYS. K.J.Standley and K.H.Reich.
Proc. Phys. Soc. B, Vol. 68, Pt 10, 713-22 (Oct., 1955).

From microwave resonance measurements, g values and line widths for nickel and for Ni-Cu, Ni-Al, Ni-Sb and Ni-Mn alloys with high nickel content have been determined. Measurements were made at a wavelength of 1.22 cm and usually in the temperature range 20-200°C. A constant temperature-independent g value of 2.19 ± 0.02 was found for all specimens except the Ni-Mn alloys; for these a decrease in g value with increase in manganese content occurred, reaching 2.11 for the 13.5 atomic per cent Mn alloy. An explanation of this behaviour is given. Absolute absorption measurements were made and the line widths are expressed in terms of the damping constant $1/T_2$ introduced by Bloembergen (1950). For a given alloy the shape of the curve of $1/T_2$ against reduced temperature is similar to that found by Bloembergen for nickel but varies from alloy to alloy. A single curve of exponential form is found to represent the results when $1/T_2$ is plotted against saturation intensity of magnetization M, an increase in $1/T_2$ accompanying a decrease in M. A possible explanation is qualitatively presented. A.

538.221

1364. FERRIMAGNETIC RESONANCE IN SINGLE CRYSTALS OF MANGANESE FERRITE. J.F.Dillon, Jr, S.Geschwind and V.Jaccarino.
Phys. Rev., Vol. 100, No. 2, 750-2 (Oct. 15, 1955).

Reports measurements on small spherical monocrystalline specimens of $Mn_{0.98}Fe_{1.86}O_4$ between 4° and 300°K at frequencies 5.9, 9.3 and 23.8 k Mc/s. Very small line widths were obtained, 50-60 oersted at room temperature depending on orientation. The first and second anisotropy constants were measured over the whole temperature range; K_1/I_0 was found to decrease smoothly with increasing temperature and K_2/I_0 to be small except at the lowest temperatures (K_2/K_1 = about ½ at 4°K). The g value was found to be independent of frequency but dependent on temperature; the room temperature value is 2.004 ± 0.002, indicating spin-only ferrimagnetism corresponding to a $^6S_{5/2}$ groundstate of Mn^{++}. The work described represents the first exhaustive study of a ferrite single crystal. E.P.Wohlfarth

538.221

1365. FERRIMAGNETIC RESONANCE AND SOME RELATED EFFECTS. R.K.Wangsness.
Amer. J. Phys., Vol. 24, No. 2, 60-6 (Feb., 1956).

The semiclassical resonance theory for a system of coupled magnetic sublattices is briefly reviewed and some similarities and differences of ferromagnetic and ferrimagnetic resonance considered. The use of the effective gyromagnetic ratio simplifies the interpretation of many experimental results for g-values. The qualitative application of this concept to some related phenomena shows that they can have features characteristic of the ferrimagnetic case. A.

538.221

1366. FREQUENCY DEPENDENCE OF MAGNETOCRYSTALLINE ANISOTROPY. R.M.Bozorth, B.B.Cetlin, J.K.Galt, F.R.Merritt and W.A.Yager.
Phys. Rev., Vol. 99, No. 6, 1898 (Sept. 15, 1955).

For $(NiO)_{0.7}Fe_2O_3$, static and microwave determinations of K_1 give practically identical results at room temperature but markedly different results at −196° C. The frequency dependence is ascribed to a rearrangement of electrons between Fe ions. For a Mn ferrite, K_1 was found to be practically independent of frequency. E.P.Wohlfarth

538.221

1367. ORIGIN OF THE UNIAXIAL ANISOTROPY IN IRON-COBALT FERRITES. S.Iida, H.Sekizawa and Y. Aiyama.
J. Phys. Soc. Japan, Vol. 10, No. 10, 907 (Oct., 1955).

Describes experiments on solid solutions of magnetite and cobalt ferrite with Fe/Co between 7.5 and 12.0. The uniaxial anisotropy induced by magnetic annealing was found to be very sensitive to the degree of oxidation. The anisotropy is suggested to be a result of directional order between Co^{++} ions and cation vacancies, the degree of order being determined by the diffusion rate of cations during the cooling process.
E.P.Wohlfarth

538.221

1368. MAGNETIC MOMENT ARRANGEMENTS AND MAGNETOCRYSTALLINE DEFORMATIONS IN ANTIFERROMAGNETIC COMPOUNDS. Y.-Y.Li.
Phys. Rev., Vol. 100, No. 2, 627-31 (Oct. 15, 1955).

The neutron-diffraction data of Shull et al. on the powder specimens of MnO, FeO, CoO, etc., are re-examined. It is found that except for FeO the observed Debye–Scherrer patterns may be produced by a number of magnetic moment arrangements with the antiparallel coupling among the moments on the next nearest neighbouring ions, but with different sublattice correlations and different orientations of magnetic axis (or axes). The symmetry change observed at the Néel point is interpreted as a strong effect of spontaneous anisotropy magnetostriction. As a consequence the uniaxial direction of the modified symmetry must coincide with that of the magnetic axis. Assignments of antiferromagnetic arrangements for the compounds are reached. The prescription does not agree with that of Shull et al. except in the case of FeO. The sharp readjustment of lattice parameters at the transition temperature and the orientation of spin axis in other antiferromagnetic compounds are discussed from the viewpoint of the anisotropy-magnetostriction approach. A.

538.221

1369. INFLUENCE OF MAGNETIC FIELD ON THE PRECIPITATION PROCESS OF FERROMAGNETIC PHASE IN Cu–Co ALLOY. T.Mitui and S.Miyahara.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1023 (Nov., 1955).

The uniaxial anisotropy of an alloy containing 2% Co in which precipitation occurred after annealing in a magnetic field (1000-2000 oersted) is shown by torque measurements to have its origin in a shape effect rather than in the effect of directional order. E.P.Wohlfarth

538.221

1370. ON THE MAGNETIC AGEING OF (COMMERCIALLY) PURE IRON. II. M.Asanuma and S.Ogawa.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1025-6 (Nov., 1955).

For Pt I, see Abstr. 5511 (1955). The decrease of the initial susceptibility of iron on tempering near 130°C is shown by internal friction measurements to be mainly due to the precipitation of disk-shaped particles of the phase $Fe_{16}N_2$; the phase Fe_4N has similar but less pronounced effects. E.P.Wohlfarth

538.221

1371. ELECTRICAL ANALOG OF THE EDDY-CURRENT-LIMITED DOMAIN-BOUNDARY MOTION IN FERROMAGNETICS. G.Brouwer.
J. appl. Phys., Vol. 26, No. 11, 1297-302 (Nov., 1955)

The observed losses in a ferromagnetic core are always greater than those calculated on the basis of a homogeneous permeability. In a magnetization process by domain-boundary displacements the permeability is certainly not homogeneous, but attains extreme values in the domain walls. As a result of this concentration of the changes in magnetic flux the dispersion curves of the initial permeability as a function of frequency show a shift of the dispersion region towards lower frequencies with increasing domain size. This is the well-known eddy-current anomaly encountered in laminated cores. An electric-circuit model was utilized to determine the eddy-current distribution and domain-boundary motion in a number of idealized cases. A.

538.221

1372. MAGNETIC PROPERTIES OF ERBIUM METAL. J.F.Elliott, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 100, No. 6, 1595-6 (Dec. 15, 1955).

Measurements of the magnetic moment of erbium metal in the temperature range from 20.4°K to 90°K are reported. The initial susceptibility shows a maximum at 78°K and the metal appears to become ferromagnetic near 20°K. A.

538.221 : 536.631

1373. MAGNETIC AND THERMAL PROPERTIES OF $MnCl_2$ AT LIQUID HELIUM TEMPERATURES. I. MAGNETIC SUSCEPTIBILITY. R.B.Murray and L.D.Roberts.
Phys. Rev., Vol. 100, No. 4, 1067-70 (Nov. 15, 1955).

Measurements of the magnetic susceptibility of polycrystalline and single-crystal samples of anhydrous $MnCl_2$ have been carried out from 1.1° to 4.2°K with an a.c. mutual-inductance bridge. The susceptibility was found to be essentially independent of an applied magnetic field up to 2400 oersteds throughout this region, and displayed anomalous behaviour near 2°K indicating a magnetic ordering transition. In view of the observed susceptibility behaviour this transition is interpreted as one of an antiferromagnetic nature, although the susceptibilities of both the single-crystal and polycrystalline samples were found to rise slowly with decreasing temperature below the transition region. This interpretation is supported by preliminary neutron diffraction studies below 2°K. A calculation of the magnetic anisotropy is in reasonable agreement with that observed at 4.2°K. A.

538.221 : 536.631

1374. MAGNETIC AND THERMAL PROPERTIES OF $MnCl_2$ AT LIQUID HELIUM TEMPERATURES. II. SPECIFIC HEAT. R.B.Murray.
Phys. Rev., Vol. 100, No. 4, 1071-4 (Nov. 15, 1955).

The specific heat of anhydrous $MnCl_2$ has been measured from 1.25° to 4.2°K in a search for the anomaly associated with the magnetic transition observed near 2°K. The measuring techniques are discussed briefly. The results of a series of experiments show two λ-type anomalies, each of magnitude 12 joules/mole.degree, located at 1.81° and 1.96°K. These two maxima are interpreted as arising from a multiple transition from the paramagnetic to an antiferromagnetic state. A plot of magnetic-entropy v. temperature, obtained by integration of the specific heat data, shows that approximately $\frac{2}{3}$ of the available spin entropy has been achieved at the upper transition point. A.

538.221 : 538.615

1375. PHOTO-ELECTRON EMISSION IN A FERROMAGNETIC. A.Z.Veksler.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 201-8 (1955). In Russian.

Formulae determining the velocity distribution of the photoelectrons and the temperature relation of the photocurrent near the Curie point are derived. The calculations are based on Vonsovskii's s-d exchange model and consider the periodic lattice potential by the method of variation of the parameters. The photocurrent is found to depend on the square of the magnetization, which agrees with Cardwell's results. Electrical Research Association

538.221 : 538.63

1376. GALVANOMAGNETIC EFFECTS IN BISMUTH. B.Abeles and S.Meiboom.
Phys. Rev., Vol. 101, No. 2, 544-50 (Jan. 15, 1956).

Conductivity, Hall effect, and magnetoresistance in single crystals of pure and tin-doped bismuth have been measured as functions of temperature between 80 and 300°K and as functions of magnetic field up to 2000 oersted. A simple many-valley model for the band structure of bismuth is proposed, and explicit expressions for the galvanomagnetic effects are derived. Numerical values are obtained for the number of conduction electrons and holes, their mobilities, and the overlap of valence and conduction bands. A.

538.221 : 538.653.11

1377. PRODUCTION OF ANISOTROPY IN A PERMANENT MAGNET BY PRESSURE. J.E.Gould and M.McCaig.
Nature (London), Vol. 176, 977 (Nov. 19, 1955).

The demagnetization curve of a 35% Co steel (H_c = 200 oersted) was found to be squarer after application of lateral compression to a bar specimen. E.P.Wohlfarth

538.221 : 548.736.3

1378. THE MAGNETIC PROPERTIES AND PHASE DIA-

GRAM OF IRON TELLURIUM SYSTEM. S.Chiba.
J. Phys. Soc. Japan, Vol. 10, No. 10, 837-41 (Oct., 1955).

It was found by X-ray and thermal analysis that a number of intermetallic compounds are formed from the melt through peritectic reactions, and an eutectoid reaction was seen to occur between two compounds α (Fe—Te) and β ($Fe—Te_2$) at 520° C, the reaction product having NiAs structure. The α-phase shows an antiferromagnetic behaviour with asymptotic Curie temperature $\theta = 130°K$ and Curie—Weiss constant $C = 0.57$, but the crystal lattice type of this compound is obscure at present. The β-phase has a crystal lattice of the markasite type and is antiferromagnetic, with $\theta = 67°K$ and $C = 1.31$. The γ-phase, which has a crystal lattice of the NiAs type, shows an antiferromagnetic behaviour, with $\theta = 800°K$ and $C = 1.15$. The antiferromagnetism of these compounds is briefly discussed. A.

538.222

1379. THE DYNAMIC METHOD OF STUDYING NUCLEAR PARAMAGNETISM. N.M.Pomerantsev.
Uspekhi fiz. Nauk, Vol. 55, No. 1, 3-48 (1955). In Russian.

A general survey of the topic with 80 up-to-date references. One half of the paper is devoted to the theory of the magnetic resonance of atomic nuclei including the fine structure of absorption lines and the magnetic screening of nuclei. The rest of the paper is equally divided between a discussion of apparatus and the C.W. and pulse methods of experiment, and a discussion of results obtained and applications of magnetic resonance. C.R.S.Manders

538.222

1380. OBSERVATION OF BEATS IN ELECTRON MAGNETIC RESONANCE. R.Beeler, D.Roux, G.Béné and R.Extermann.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 472-4 (Aug. 1, 1955). In French.

Beats, analogous to those of nuclear magnetic resonance, have been observed in the electron resonance spectrum at 23 Mc/s and 8.2 gauss of Na in liquid NH_3 when the modulation field producing rapid passage, 15 000 gauss/sec., through the resonance is provided by a 1.1 gauss, 2 kc/s magnetic field. D.H.Whiffen

538.222

1381. PARAMAGNETIC RESONANCE IN SEMIQUINONE IONS OF SUBSTITUTED o-BENZOQUINONES. R.Hoskins.
J. chem. Phys., Vol. 23, No. 10, 1975-6 (Oct., 1955).

538.222

1382. MULTIPLE THIO-RADICALS IN SULFURIC ACID SOLUTION. J.E.Wertz and J.L.Vivo.
J. chem. Phys., Vol. 23, No. 11, 2193-4 (Nov., 1955).

Thiophenols in sulphuric acid give two electron resonance absorption peaks, $g = 2.0151$ and 2.0081 for p-thiocresol, each with hyperfine structure. The former is believed to be due to radicals such as $(C_6H_5S.)H^+$ and it slowly disappears. The second line is permanent and is similar to that obtained with thianthrene. D.H.Whiffen

538.222

1383. RE-EXAMINATION OF TWO FREE RADICALS. J.E.Wertz, C.F.Koelsch and J.L.Vivo.
J. chem. Phys., Vol. 23, No. 11, 2194 (Nov., 1955).

A narrow electron resonance $\Delta H_{\frac{1}{2}} = 0.96$ gauss, $g = 2.0025$ was found for pentaphenyl cyclopentadienyl at 9000 Mc/s. For tri-tert.-butyl phenoxyl $\Delta H_{\frac{1}{2}} = 7.7$ gauss and $g = 2.0052$ and α, γ bis diphenylene-β-phenylallyl had $\Delta H_{\frac{1}{2}} = 0.66$ gauss and $g = 2.0025$, all in the solid state. D.H.Whiffen

538.222

1384. RAPID PASSAGE EFFECTS IN ELECTRON SPIN RESONANCE. A.M.Portis.
Phys. Rev., Vol. 100, No. 4, 1219-21 (Nov. 15, 1955).

The dispersion signal obtained from F-centres in LiF at room temperature lags by almost 90° the modulated magnetic field, and the shape of the resonance line as a function of the magnetic field resembles an absorption curve. The line broadening for F-centres is attributed to hyperfine interaction, and the phase lag is interpreted in terms of Bloch's rapid passage theory (Abstr. 407/1947). F.Ansbacher

538.222

1385. ELECTRON SPIN RESONANCE OF SEMIQUINONES. J.E.Wertz and J.L.Vivo.
J. chem. Phys., Vol. 23, No. 12, 2441-2 (Dec., 1955).

Derivative curves are presented for the electron spin resonance of reduced p-benzoquinone and its monochlor-, 2 : 3-dichlor-, trichlor- and tetrachlor- derivatives in alcohol. n + 1 hyperfine peaks are resolved where n is the number of H atoms present. D.H.Whiffen

538.222

1386. PARAMAGNETIC RESONANCE IN SOLUTIONS OF OXIDIZED PYROGALLOL. R.H.Hoskins and B.R.Loy.
J. chem. Phys., Vol. 23, No. 12, 2461-2 (Dec., 1955)

538.222

1387. PROTON RELAXATION TIMES IN H_2O - D_2O MIXTURES. W.A.Anderson and J.T.Arnold.
Phys. Rev., Vol. 101, No. 2, 511-12 (Jan. 15, 1956).

The relaxation time, T_1, of protons in H_2O - D_2O mixtures has been measured and found to depend strongly upon the relative proton concentration. This dependence supports the assumption of Bloembergen, Purcell and Pound that the main relaxation mechanism in water is a nuclear dipole interaction. A.

538.222 : 539.13

1388. MICROWAVE SPECTROSCOPY OF BIOLOGICAL SUBSTANCES. I. PARAMAGNETIC RESONANCE IN X-IRRADIATED AMINO ACIDS AND PROTEINS. W.Gordy, W.B.Ard and H.Shields.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 11, 983-96 (Nov., 1955).

Paramagnetic electron resonance spectra are obtained for crystalline glycine, alanine, valine, cystine and other amino acids and for hair, toe nail, feather, silk and other natural proteins, after irradiation with 50 kV X-rays. The spectra are interpreted in terms of the radicals formed which include $C_2H_4^+$, $C_2H_6^+$, R-S-S-R^+ etc. The trapped radicals are stable for several months in the absence of O_2. D.H.Whiffen

538.222 : 539.13

1389. MICROWAVE SPECTROSCOPY OF BIOLOGICAL SUBSTANCES. II. PARAMAGNETIC RESONANCE IN X-IRRADIATED CARBOXYLIC AND HYDROXY ACIDS. W.Gordy, W.B.Ard and H.Shields.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 11, 996-1004 (Nov., 1955).

Paramagnetic electron resonance spectra are obtained for crystalline acetic, propionic, formic, oxalic, lactic and other acids, after irradiation with X-rays. The spectra vary with thermal treatment and are interpreted in terms of the radicals CH_2CO^+, CH_3CO_2, $HCOOH^+$, HCO, CH_3 etc., which are trapped in the solid. $Zn(CH_3)_2$ at 77° K gives CH_3 radicals which are pyramidal, and $Hg(C_2H_5)_2$ gives C_2H_5 radicals in which the five H couple equally to the electron, suggesting that the H readily changes ends. D.H.Whiffen

538.222 : 548.7

1390. ELECTRON SPIN RESONANCE OF V_1-CENTERS. W.Känzig.
Phys. Rev., Vol. 99, No. 6, 1890-1 (Sept. 15, 1955).

Electron resonance of V_1-centres (hole bound to positive

ion vacancy) shows hyperfine splitting which is anisotropic. For KCl irradiated with X-rays at -180°C the seven hyperfine groups of lines were observed with splitting 10-100 gauss between groups depending on orientation. The pattern is consistent with the centre being a Cl_2^- ion near a positive ion vacancy. The wave-functions of the halogens are 30% s and 70% p in character and $|\psi(0)|^2 = 1.9 \times 10^{24}$ cm^{-3}.

D.H.Whiffen

538.224

1391. MAGNETIC SUSCEPTIBILITY OF LOW RESISTIVITY N-TYPE GERMANIUM. F.T.Hedgcock.
Canad. J. Phys., Vol. 34, No. 1, 43-9 (Jan., 1956).

Some results for polycrystalline germanium as observed between room and liquid nitrogen temperatures are presented. The contribution to the susceptibility from both the free and bound charge carriers has been derived from the experimental results and appears to vary inversely with temperature. An effective mass for the charge carriers in n-type germanium is found to be 0.16 of the free electron mass. A.

538.24

1392. MEASUREMENTS OF THE REVERSIBLE PERMEABILITY AND THEIR THEORETICAL INTERPRETATION. H.Wilde.
Z. angew. Phys., Vol. 7, No. 11, 509-13 (1955). In German.

Discusses the field dependence of μ_r of a material for which the magnetization process is a movement of 180° domain walls. The largest contribution to μ_r is made by those boundaries which are about to perform Barkhausen jumps. By calculating these contributions and also those from boundaries which have just completed a jump, and averaging over all boundaries by a simple statistical method, μ_r–H curves are obtained which are in good agreement with the observed curves for a ferrite material. E.P.Wohlfarth

538.24 : 539.67

1393. MAGNETIC INTERNAL FRICTION PEAK IN NICKEL. K.Míšek.
Czech. J. Phys., Vol. 5, No.3, 420-1 (Aug., 1955).

Internal friction peaks were observed during application of direct and alternating fields to specimens of nickel with and without carbon impurities. The effect is dependent on frequency, temperature and cold working. E.P.Wohlfarth

538.248 : 538.652 : 548

1394. RESIDUAL MAGNETIZATION AND MAGNETOSTRICTION OF NICKEL SINGLE CRYSTALS. Y.Nakamura.
J. Phys. Soc. Japan, Vol. 10, No. 11, 937-41 (Nov., 1955).

By the use of long cylindrical single crystals of pure nickel with various crystallographic orientations, magnetization and magnetostriction were measured at room temperature. It was found that the remanent magnetization I_r is given approximately by the following relation: $I_r/I_s = 1/\sqrt{3}\beta_1$, where I_s is the saturation magnetization and β_1 is the direction cosine of the rod axis with respect to the nearest [100] direction. On the basis of this relation the magnetostriction constants and also the crystal anisotropy constants were determined. Magnetostriction curves constructed theoretically from the obtained values of magnetostriction constants agree with the experimental curves. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3

1395. ON THE ENERGY-MOMENTUM TENSOR OF THE ELECTROMAGNETIC FIELD IN DIELECTRICS. G.Marx and G.Györgyi.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 241-56 (1955). In German.

See Abstr. 10345 (1954).

538.3

1396. ON ELECTROMAGNETIC INDUCTION. P.Moon and D.E.Spencer.
J. Franklin Inst., Vol. 260, No. 3, 213-26 (Sept., 1955).

It is pointed out that the phenomenon of electromagnetic induction has led to many controversies, and the paper explains how these may be avoided, as well as all ambiguities, by abandoning the concept of the magnetic field and basing the discussion on the concept of inter-particle forces (see Abstr. 2896/1955). The new electrodynamics is introduced and several examples are discussed. L.S.Goddard

538.3 : 621.3.011

1397. ELECTROMAGNETIC MOMENTUM AND ELECTRON INERTIA IN A CURRENT CIRCUIT. E.G.Cullwick.
Proc. Instn Elect. Engrs, Monogr. No. 150, publ. Sept., 1955 (Vol. 103 C, 159-70).

The kinetic energy of the conduction electrons in a current circuit is identified with the magnetic energy of the current, so that electron-inertia effects may be included in the general electromagnetic scheme. As a result a current circuit possesses an electromagnetic "mass", and the momentum of this, when current flows, accounts for the known effects of electron inertia and also for the force on the end-wire of a long rectangular circuit. The relativistic form of the theory indicates a possible departure of the electromagnetic laws from classical form, and the hypothesis indicates a unified theory covering both conductors and superconductors. L.S.Goddard (R)

538.522

1398. A STANDARD OF MUTUAL INDUCTANCE. J.T.Henderson and M.Romanowski.
Canad. J. Phys., Vol. 33, No. 12, 856-70 (Dec., 1955).

A primary standard of mutual inductance of the Campbell type has been constructed by the National Research Council to serve as an ultimate standard of reference for electrical quantities in Canada. The electrical value is computed from its measured physical dimensions. A detailed description is warranted in view of its national importance. The value of the standard is $0.010\,007\,24_8$ henry with an error not larger than 13 p.p.m. A.

538.522

1399. CONSIDERATIONS ON THE PRIMARY WINDING OF THE CAMPBELL STANDARD INDUCTOR. M.Romanowski and P.A.Fraser.
Canad. J. Phys., Vol. 33, No. 12, 871-85 (Dec., 1955).

The effect of the presence of the quartz cylinder on the mutual inductance of the N.R.C. standard is examined using the expression for the energy of the circuit made of the primary and the secondary connected in series. The analysis and the computation show that the volume susceptibility of the quartz, equal to $-4\pi \times 0.39 \times 10^{-6}$ (in m.k.s. rationalized units), produces a decrease of the mutual inductance of the order of 2 parts in 10^6. In the second section the effect of the finite cross-section of the primary wire is examined. The assumption that the current is concentrated in the central filament of the wire was in several past cases considered as sufficient. The computation given here shows that this effect is not negligible and on the actual N.R.C. standard amounts to 3 or 4 parts in 10^6. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

1400. THE FOUR POSSIBLE WAVES IN IONIZED GAS IN A MAGNETIC FIELD. J.H.Piddington.
Nature (London), Vol. 176, 875-6 (Nov. 5, 1955).

It is reported that the solution of the field equations, together with suitable momentum transfer equations, leads to a

lispersion equation of the fourth degree, indicating four pos-ible wave types in a fully ionized gas. R.A.Newing

538.56 : 532.5

401. HYDROMAGNETISM. I. A REVIEW. W.M.Elsasser.
Amer. J. Phys., Vol. 23, No. 9, 590-609 (Dec., 1955).

Gives a survey of the theories and phenomena of cosmic magnetism, extending from geomagnetism over solar and sunspot magnetism to stellar and interstellar magnetic fields. The theoretical treatment is purely classical and Maxwellian. Most cosmic fluids, being highly ionized, are excellent conductors; this implies that the displacement current can always be neglected. The fundamental equations of hydromagnetism are the electromagnetic field equations together with the hydrodynamic equation, both containing coupling terms between magnetic field and motion. Among other theoretical developments, the "dynamo" theory which ascribes the cosmic magnetic fields to amplifying processes in the moving fluid is described and it is shown that it is well suited to represent the observed phenomena of the generation and maintenance of cosmic magnetic fields. A.

538.56 : 532.51

402. ON THE MAGNETO-HYDRODYNAMICS OF COMPRESSIBLE MEDIA. R.W.Larenz.
Z. Naturforsch., Vol. 10a, No. 9-10, 761-5 (1955). In German.

When in a plasma one has to do with macroscopic velocities approaching or exceeding the velocity of sound, separation of the positive and negative charges must be considered. This phenomenon is studied for a two-component plasma, and it is shown that the system of magneto-hydrodynamic equations may be expressed by means of only two quantities, the vector potential and the plasma velocity. L.Pincherle

538.56 : 532.51 : 537.591

403. PLASMA CURRENTS OF LARGE AMPLITUDE AND CHARGE SEPARATION. R.W.Larenz.
Z. Naturforsch., Vol. 10a, No. 9-10, 766-76 (1955). In German.

Equations are set up for the propagation of one-dimensional longitudinal waves of finite amplitude in a compressible plasma assuming an adiabatic equation of state. Illustrative integrations are made for periodic and aperiodic electronic and ionic "sound" waves, and the dependence on temperature of maximum local charge separation is investigated. R.A.Newing

538.561

404. PLASMA OSCILLATIONS AT EXTREMELY HIGH FREQUENCIES. M.A.Lampert.
J. appl. Phys., Vol. 27, No. 1, 5-11 (Jan., 1956).

Plasma oscillations are treated for a frequency range having application not only to gaseous discharges but also to solids such as impurity semiconductors. Amplification of longitudinal electrostatic waves in a plasma may be achieved through energy exchange with a synchronously travelling electron beam, this being the same mechanism which underlies amplification in the travelling-wave tube. The dispersion equation describing this beam-plasma interaction, first derived by Bohm and Gross, is studied systematically to obtain the characteristics of the growth-in-time, ω v. k, of standing plasma waves and the complex propagation constant k v. ω for travelling plasma waves, at extremely high frequencies (high plasma densities). The problem of collision damping is also discussed. The possible application of plasma oscillations to the solution of the problem of the generation of millimetre-wave power is considered, both for plasmas in gaseous discharges and for the thermally generated plasmas in impurity semiconductors. A.

538.565 : 621.317.39.029.5

1405. MEASUREMENT OF THE REFRACTIVE INDEX AT RADIO WAVELENGTHS OF GASES AT ATMOSPHERIC PRESSURE. F.Bruin and F.W.Heineken.
Onde élect., Vol. 35, 502-3 (May, 1955). In French.

Short description of a technique by which the refractive index of a gas is obtained from precision measurements of the displacement of a piston in a cavity resonator necessary to keep the resonant frequency the same when filled with the gas as when it is evacuated. Careful temperature corrections must be applied. No results are given. G.M.Brown

538.565 : 621.317.79.029.6

1406. AN APPARATUS FOR STUDYING THE DISPERSION OF GASES AND VAPOURS IN THE ULTRA-HIGH-FREQUENCY BAND. A.Battaglia and A.Gozzini.
Onde élect., Vol. 35, 500-2 (May, 1955). In French.

Description of apparatus which measures the difference in the refractive indices (Δ n) of a gas at two frequencies (one double the other) from measurements of the response of two cavity resonators filled with the gas. The cavities are such that, when evacuated, they resonate to frequencies f and 2f respectively. The time difference between the resonant responses of the gas-filled cavities as the frequency sweeps through is measured and related to f and Δ n. G.M.Brown

538.566

1407. REFLECTION OF A PLANE ELECTROMAGNETIC WAVE BY AN IONIZED GAS. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 241, No. 9, 649-51 (Aug. 29, 1955). In French.

Corrects an error in two previous papers by the author (Abstr. 9784-5/1955) in which an asymptotic expansion of a Hankel function has been used outside its range of validity. G.D.Sims

538.566

1408. SOME PROBLEMS ON OBSTACLES IN A FIELD OF ELECTROMAGNETIC RADIATION. M.Bouix.
Ann. Télécomm., Vol. 10, No. 11, 243-51 (Nov., 1955). In French.

After a mathematical introduction relating to coordinate systems and some formulae in vector analysis, a study is made of the reflection and refraction at the surface of separation S of two dielectrics. The formulae obtained apply to a plane elliptically polarized wave when S is an infinite plane. The paper is to be continued. L.S.Goddard

538.566

1409. TENSOR SCATTERING MATRIX FOR THE ELECTROMAGNETIC FIELD. D.S.Saxon.
Phys. Rev., Vol. 100, No. 6, 1771-5 (Dec. 15, 1955).

The scattering of an arbitrary incoming electromagnetic wave by an unrestricted scattering object is described in terms of a tensor scattering matrix. General reciprocity relations and the cross-section theorem, including an interesting extension, are established using this representation. The results are related to the special case of plane-wave scattering and the scattering matrix is explicitly exhibited in terms of the plane-wave scattering amplitude for two mutually perpendicular directions of polarization. A.

538.566.3 : 518.5

1410. PROPOSALS FOR THE STUDY OF IONOSPHERIC INTERACTION BY MEANS OF AN ANALOGUE COMPUTER. M.Carlevaro.
Elettrotecnica, Vol. 42, No. 9, 497-8 (Sept. 10-25, 1955). In Italian.

A method is described of obtaining solutions to a differential equation encountered in the study of the motion of an electron in a nonlinear magnetic field. V.G.Welsby

MOLECULAR AND ATOMIC STRUCTURE 539.1
THEORY OF SOLID STATE 539.11

539.11

1411. INTER-ATOMIC FORCE LAW AND EQUATION OF STATE OF SOLIDS. B.Dayal and R.S.Sharma.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1049-53 (Dec., 1955).

The pressure of a solid has been divided into two terms p_1 and p_2, of which the first is the static part due to a non-vibrating lattice at T = 0, and the second arises from the thermal vibrations. For all volumes measured at zero pressure the two are equal and opposite to each other. The static pressures of eight solid elements, aluminium, copper, silver, gold, lead, platinum, tungsten and molybdenum, have been obtained from their thermal pressures $\overline{\gamma}\,E/V$ by the use of the above condition. The average Gruneisen constant $\overline{\gamma}$ has been calculated in the usual way from the thermal expansion and the specific heat data. These static pressures have been compared with the derivatives of the potential energy as derived from the inter-atomic potential used earlier by Fürth, and a very close agreement has been observed between them. A.

539.11

1412. A SIMPLE APPROXIMATION TO THE ELECTRON THEORY OF THE TRANSITION METALS. E.Glatzel and H.Schlechtweg.
Z. Naturforsch., Vol. 10a, No. 9-10, 777-83 (1955). In German.

A variational method is used for investigating the energy bands in the transition metals in which there is an s-electron outside an incompletely filled d-shell. C.A.Hogarth

539.11

1413. BONDING IN THE ZINC FAMILY METALS. W.E.Wallace.
J. chem. Phys., Vol. 23, No. 12, 2281-94 (Dec., 1955).

Attention is directed to the very large departures of the structures of the zinc family (IIb) metals from those produced by the close packing of spheres. This seems to indicate that cohesion in these metals differs considerably from the normal nondirectional metallic bonding. It is proposed that there is a system of covalent bonds in the basal plane resulting from bonding orbitals which are hybrids of one of the d and two of the p atomic orbitals. These absorb some of the s electrons and leave only 1.33 electrons/atom in the s band. Support for the proposed bonding scheme is provided by showing that with it one can account for many otherwise puzzling properties of the IIb metals and their alloys. The properties which are discussed in terms of the proposed scheme are (1) the abnormally large axial ratios in zinc and cadmium, (2) the effect of temperature on the axial ratios of these metals and the alloys of magnesium and cadmium, (3) the effect of alloying on the axial ratio, (4) the dependence of the axial ratio on the degree of order in $MgCd_3$, (5) the great abundance of Schottky defects in certain magnesium–cadmium alloys, (6) the asymmetry of the heats of alloying of magnesium and cadmium, (7) the structure of solid mercury, (8) electrical conductivities of the solids, (9) the positive Hall coefficient for zinc and cadmium, (10) the poor solvent power of these metals as solids, and (11) certain unusual features of the electrical conductivities of the liquid metals and the dilute amalgams. A.

539.11

1414. A UNIFIED STATISTICAL TREATMENT OF THE VALENCE ELECTRONS IN METALS. W.R.Theis.
Z. Phys., Vol. 142, No. 5, 511-17 (1955). In German.

A pressure–density relation for aluminium is obtained theoretically, using the Thomas–Fermi method. It is shown that a considerable pressure range can be covered if the usual statistical expression for the energy is retained, and the total electron density is split up with a contribution from the valence electrons, and a contribution which arises from the remaining electrons. P.T.Landsberg

539.11

1415. PHYSICAL IDEAS OF THE METHOD OF ELEMENTARY EXCITATIONS (MULTIPLE-ELECTRON PROBLEM IN THE THEORY OF THE SOLID STATE). V.L.Bonch-Bruevich.
Uspekhi fiz. Nauk, Vol. 56, No. 1, 55-76 (1955). In Russian.

Review dealing almost entirely with Russian work on the theory of metals and of the solid state. 68 refs. C.R.S.Manders

539.11

1416. A SURVEY OF IRRADIATION EFFECTS IN METALS. J.W.Glen.
Advances in Phys., Vol. 4, 381-477 (Oct., 1955).

Radiation damage may be caused by all kinds of energetic radiation, though its detailed character is different for neutrons, fast light nuclei, and electrons. The ideas involved in the interpretation of annealing behaviour are summarized. The experimental investigations quoted include changes of resistivity of metals, alloys and semiconductors and the annealing of these changes, the effects on mechanical properties X-ray diffraction, and on phase changes. One section deals with analogous changes in non-metals. It is concluded that most of the damage can be described in terms of interstitial atoms and vacancies, that the number produced per unit flux is approximately calculable, but that reliable indentification of defects responsible for particular effects cannot yet be mad W.M.Lomer

539.11 : 548.7

1417. THE DISPLACEMENT OF ATOMS IN SOLIDS BY RADIATION. G.H.Kinchin and R.S.Pease.
Rep. Progr. Phys., Vol. 18, 1-51 (1955).

A detailed survey of the field from both theoretical and experimental sides. The production of displaced atoms by moving atoms and by bombarding neutrons, protons, electrons and other projectiles is discussed, first in terms of threshold energy considerations and then in terms of actual numbers of displacements caused, estimated by fairly detailed work using plausible collision cross-sections in various relative energy ranges. The results of these calculations agrees fairly well with earlier theoretical treatments and are presented in convenient tabular form. The spatial distribution of interstitial atoms and vacancies is very non-uniform in heavy-particle bombardment, and the thermal and displacement spike models involving local melting are described and criticized. The usual analysis of recovery rates is quoted. A useful summar of the convenient energy and flux obtainable in different ways is given. Results are quoted for experiments on the resistance, density changes and yield stresses of metals, on the resistivity of ordering alloys, on diffusion experiments and on precipitation kinetics in alloys. Semiconductors have given detailed results on numbers of electron traps produced and on their energy, though none has yet been identified with a definit atomic configuration. Covalent compounds show larger effect than most other classes of compound, many of them being tra formed to the "metamict" state in which crystal structure is entirely destroyed, leaving a glassy substance. Detailed stud ies of X-ray properties have given valuable results which sho that it is not easy to classify all covalent compounds together in a single category. W.M.Lomer

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1418. EFFECT OF NEUTRON IRRADIATION ON THE PRECIPITATION-HARDENING REACTION IN ALLOYS CONTAINING BERYLLIUM. R.H.Kernohan, D.S.Billington and A.B.Lewis.
J. appl. Phys., Vol. 27, No. 1, 40-2 (Jan., 1956).

Neutron irradiation effects in the precipitation hardening alloy, nickel-beryllium, were measured using the ferromagnetic Curie temperature as an index of the amount of precipi-

te formed. Effects found previously in a similar precipitat-n hardening alloy, copper-beryllium, were not found upon radiation at approximately room temperature. However, an radiation for an integrated fast flux of 4×10^{17} n/cm^2 at a mperature of 300° C showed that 1.3 atomic percent more eryllium in the form of the compound Ni-Be precipitated from supersaturated solid solution than a similar specimen held at 00° C but not irradiated. A.

539.11 : 548.7

419. UNIFORM STRAINS AND DEFORMATION POTENTALS. R.H.Parmenter.
Phys. Rev., Vol. 99, No. 6, 1767-76 (Sept. 15, 1955).

A perturbation method of calculating the energy levels f a crystal modified by an arbitrary uniform strain is studed. A modified form of first-order perturbation theory is sed, a form particularly appropriate to cases where the unerturbed wave-functions are expanded in terms of orthogonaized plane waves. Not only are the conventional uniform trains considered but also the special types of deformations hereby the relative positions of the atoms in a unit cell are hanged without distorting the Bravais lattice of the crystal. Thus the results of this paper may be applied to the deformaion-potential theory of mobility with regard to both acoustic nd optical lattice vibrations. A.

539.11 : 548.7

20. SYMMETRY PROPERTIES OF THE ENERGY BANDS F THE ZINC BLENDE STRUCTURE. R.H.Parmenter.
ys. Rev., Vol. 100, No. 2, 573-9 (Oct. 15, 1955).

The symmetry properties of the one-electron energy bands a crystal of the zinc blende structure are studied by means group theory. This is done both with and without the inusion of spin-orbit coupling. The character tables and comtability tables are obtained for the various irreducible reesentations of the space group T_d^2 associated with the zinc ende structure. The degeneracies and the gradients of the rious possible energy bands are studied at lines and points symmetry in the Brillouin zone. These results are comred with those for the equivalent energy bands in a crystal the diamond structure. A.

MOLECULES 539.13

539.13 : 539.132

21. MOLECULAR ASSOCIATION AND PROTON RESOANCE IN ACETIC ACID. B.N.Bhar, W.Forsling and Lindström.
rk. Fys., Vol. 10, Paper 6, 59-63 (1955).

For acetic acid dimer the chemical shift between the sonance of the carboxyl protons and the $-CH_3$ group protons 24.1×10^{-3} gauss, with the CH_3 resonance at higher field, hen measurements are made at 13.997 Mc/s and 3285 gauss. his value is essentially unchanged in CS_2, CCl_4 and C_6H_6 lutions. In H_2O the dimers are destroyed on dilution and e H_2O and the –COOH protons give a single resonance peak hose position is concentration-dependent, and depends on e time average of the diamagnetic shielding as the proton is changed between the acid and the water molecules.
D.H.Whiffen

539.132 : 539.153.4 : 539.181

22. RESONANCE TRANSITIONS IN MOLECULAR BEAMS XPERIMENTS. II. AVERAGES OVER THE VELOCITY ISTRIBUTION. H.Salwen.
ys. Rev., Vol. 101, No. 2, 621-2 (Jan. 15, 1956).

For Pt I, see Abstr. 9796 (1955). General expressions e given for the average, over a v^3 velocity distribution, of e transition probability in a resonance line of an atomic or olecular beams experiment. Explicit expressions are given for multiple quantum transitions which are similar to those of Torrey for "allowed" transitions. The case when the complete velocity distribution is cut off on either the high- or low-velocity side or both is discussed. A.

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1423. EVALUATION OF FORCE CONSTANTS FROM RAMAN EFFECT DATA. I. MOLECULES AND RADICALS OF THE TYPE XY_4. K.Venkateswarlu and S.Sundaram.
J. chem. Phys., Vol. 23, No. 12, 2365-7 (Dec., 1955).

The force constants of 8 radicals and 6 molecules of the type XY_4 belonging to the T_d symmetry have been calculated using Raman effect data by the Wilson's F-G matrix method. Applying Badger's and Gordy's empirical rules, the X-Y internuclear distances have been calculated and compared with the available observed data. A.

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1424. EVALUATION OF FORCE CONSTANTS FROM RAMAN EFFECT DATA. II. MOLECULES AND RADICALS OF THE PLANAR XY_3 TYPE.
J. chem. Phys., Vol. 23, No. 12, 2368-9 (Dec., 1955).

The force constants of 4 molecules and 5 radicals of the planar type XY_3 belonging to the point group D_{3h} have been calculated using Raman effect data by the Wilson's G-G matrix method. Applying the empirical rules of Badger and Gordy, the X-Y internuclear distances have been calculated. A.

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1425. EXTENDED ENERGY LEVEL TABLES FOR THE RIGID ASYMMETRIC ROTOR. G.Erlandsson.
Ark. Fys., Vol. 10, Paper 7, 65-88 (1955).

The BESK computing machine was used to extend tables by King, Hainer and Cross for J = 12, or below, up to J = 40, using the same arrangement. J.Jacobs

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1426. HINDERED ROTATION OF WATER MOLECULES OF HYDRATION IN $Mg(H_2O)_6Cl_2$ AND $Mg(H_2O)_6Br_2$. T.Sidei and S.Yano.
J. chem. Phys., Vol. 23, No. 8, 1554-5 (Aug., 1955).

The proton magnetic resonance spectrum of $Mg(H_2O)_6Cl_2$ shows line shape transitions at –20 to 0° C and 100 to 110° C, at the lower of which rotational motion of H_2O probably begins.
D.H.Whiffen

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1427. THERMODYNAMIC PROPERTIES OF IDEAL GASEOUS METHANOL. E.V.Ivash, J.C.M.Li and K.S.Pitzer.
J. chem. Phys., Vol. 23, No. 10, 1814-18 (Oct., 1955).

New calculations are presented for the thermodynamic properties of methanol which are based upon the most recent spectroscopic data. The molecular constants related to the internal rotation are now well established. The vibrational assignment is discussed and additional arguments are presented for the correctness of the selections of Herzberg and Plyler. The method of statistical calculation is essentially that of Halford, but avoids an approximation. Complete thermodynamic functions are tabulated for the range 100 to 1000° K. Agreement with experimental thermodynamic data is satisfactory. A.

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1428. NEW FORM OF MOLECULAR POTENTIAL FUNCTION FOR USE IN MOLECULAR VIBRATIONAL ANALYSIS. E.J.Slowinski, Jr.
J. chem. Phys., Vol. 23, No. 10, 1933-5 (Oct., 1955).

A molecular potential function which takes simple and direct account of intramolecular strains is proposed. The parameters in the function are the conventional bond-stretching and angle-bending force constants and the strain-free magnitudes of the bond lengths and bond angles. The function is applied to the analysis of the vibrations of XY_2 molecules

with C_{2v} symmetry. Calculations based on the zero-order frequencies of H_2O and D_2O indicate that a three-parameter function is adequate for these molecules. All molecules studied with the function show a moderate attraction between the end atoms of the molecules, resulting in a decrease in the size of the bond angle from the strain-free value. For compounds of the oxygen family with hydrogen the bond angle at zero strain appears to have a constant value equal to 120°.

A.

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1429. ENERGY EXCITATION OF VIBRATIONS IN HALOMETHANE GASES. R.Amme and S.Legvold.
J. chem. Phys., Vol. 23, No. 10, 1960-1 (Oct., 1955).

Re-interpretation of data on collision lifetimes of vibrations (Abstr. 7230/1955).with a modified theoretical expression, gives better agreement with experiment, and indicates that the steric factor should be taken different for different numbers of H atoms substituted. J.Hawgood

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1430. ON THE FUNDAMENTAL VIBRATIONS OF HYDROGEN SULPHIDE. I.Gamo.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 871-2 (Oct. 3, 1955). In French.

Starting from three observed frequencies of H_2S and one of D_2S, three normal frequencies of D_2S have been calculated, using a general potential function with anharmonicity.

J.Jacobs

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1431. MICROWAVE SPECTRUM AND MOLECULAR STRUCTURE OF METHYLCHLOROACETYLENE.
C.C.Costain.
J. chem. Phys., Vol. 23, No. 11, 2037-41 (Nov., 1955).

The $J = 6 \leftarrow 5$ rotational transitions have been observed for 10 isotopic species of CH_3CCCl, including four of the fully deuterated molecule. The values for D_J were calculated from the force constants of the molecule, and are tabulated with the resulting values for B_0. The structural parameters giving the best fit to the 10 moments of inertia I_B are:
$r_0(C-Cl) = 1.6371$ A, $r_0(C \equiv C) = 1.2069$ A, $r_0(C-C) = 1.4584$ A, $r_0(C-H) = 1.117$ A, $\angle HCC = 110^0\,46'$, $r_0(C-D) = 1.114$ A, and $\angle DCC = 110^0\,30'$. The quadrupole coupling constant eqQ was determined as −79.6 Mc/s for Cl^{35} and −62.6 Mc/s for Cl^{37}. For CH_3CCCl^{35}, CH_3CCCl^{37}, CD_3CCCl^{35}, and CD_3CCCl^{37} experimental values of D_{JK} and H_{JKK} were determined from the K structure. To fit the observed fine structure it was necessary to include the third-order term H_{JKK} in the expression for the rotational energy. A.

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1432. ON THE COMMUTATOR OF TWO HOMOGENEOUS POLYNOMIALS. APPLICATION TO THE CALCULATION OF THE VIBRATIONAL ENERGY OF A POLYATOMIC MOLECULE. G.Amat, M.Goldsmith and H.H.Nielsen.
J. Phys. Radium, Vol. 16, No. 11, 854-60 (Nov., 1955). In French.

Some general formulae are established for $[A, B]$ where A, B are polynomials, homogeneous in a certain no. of coordinates and their conjugated momenta. Such commutation problems arise in second-order perturbation calculations of Van Vleck type. Second-order corrections to vibrational energy confirm the harmonicity coefficients already obtained by Nielsen. J.Jacobs

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1433. INTERNAL ROTATION IN METHYL-TRIFLUOROMETHYL ACETYLENE. D.R.Lide, Jr and D.Kivelson.
J. chem. Phys., Vol. 23, No. 11, 2191 (Nov., 1955).

The microwave spectrum (Abstr. 646/1954) previously thought to indicate a high potential barrier to internal rotation, may be explained with a zero barrier, the fine structure being ascribed to superposition of lines, from different molecule with the CH_3 and CF_3 groups in different states of unhinder rotation, split by centrifugal distortion effects. J.Hawg

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1434. INFLUENCE OF FERMI RESONANCE ON THE CE TRIFUGAL STRETCHING CONSTANT OF A LINEAR MOLE CULE. G.Amat, M.Goldsmith and H.H.Nielsen.
J. chem. Phys., Vol. 24, No. 1, 44-7 (Jan., 1956).

A theory of the influence of Fermi resonance on the ce trifugal distortion constant of a linear molecule has been de veloped and its predictions for CO_2 compared with experim The theory of those bands which exhibit simultaneous Ferm resonance and l-type doubling is also discussed.

539.132 : 532.

1435. CONCENTRATION DEPENDENCE OF SOLVENT SHIFT IN THE C–H (AND C–D) STRETCHING FREQUENCIES OF CHLOROFORM AND PENTACHLOROETHANE.
R.B.Bernstein and M.Tamres.
J. chem. Phys., Vol. 23, No. 11, 2201-2 (Nov., 1955).

The shift of these frequencies on solution in CS_2 is nega tive and varies linearly with CS_2 concentration. Shifts with a fluorochemical solvent were positive, and apparently also linear, and those with CCl_4 were small and negative. The band widths for $CHCl_3$ were independent of CS_2 concentratio while those for C_2Cl_5H decreased slightly with increasing C concentration. J.Hawgo

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1436. EXPANSION OF ELECTRONIC WAVE FUNCTIONS OF MOLECULES IN TERMS OF "UNITED-ATOM" WAVE FUNCTIONS. Tien Chi Chen.
J. chem. Phys., Vol. 23, No. 11, 2200-1 (Nov., 1955).

Theoretical. Discusses the expression of a general ma electron many-centre problem as a perturbation of the one- centre united-atom problem in two ways, the first including electron repulsion terms in the unperturbed Hamiltonian, a the second including them in the perturbation. The zero-or one-centre potentials are to be chosen for simplicity of calc lation: only relatively simple integrals are needed. In the first of the above approaches, the electron repulsion terms can be included exactly from empirical data, where availabl for the united atom problem. J.Hawgo

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1437. RELATION OF STABILITY RATIOS TO PAULING ELECTRONEGATIVITIES. R.T.Sanderson.
J chem. Phys., Vol. 23, No. 12, 2467-8 (Dec., 1955).

To facilitate a precise quantitative comparison a conve sion from stability ratio values to the units of Pauling's electronegativity is made; a table gives the converted valu and shows discrepancies for only a few elements. J.Jac

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1438. GROUND STATE OF THE HELIUM-HYDRIDE ION.
A.A.Evett.
J. chem. Phys., Vol. 24, No. 1, 150-2 (Jan., 1956).

The variational method developed by James and Coolidg is applied to the ground state of $(He H)^+$, extending the earli work of Coulson and Duncanson and of Toh. Several terms not considered previously in the power series expansion of the wave-function in elliptic coordinates were found to be ve effective in increasing the binding energy. Calculations wi a 20-term wave-function gave an equilibrium internuclear separation of 1.432 a_0 and a fundamental frequency of 3600 cm^{-1}. A 23-term wave-function established 1.68 eV as the lower limit for the corrected dissociation energy.

539.132 : 535.3

1439. THE ELECTRONIC SPECTRUM OF AROMATIC MOLECULES. VI. THE MESOMERIC EFFECT. J.N.Mur
Proc. Phys. Soc. A, Vol. 68, Pt 11, 969-75 (Nov., 1955).

For Pt V, see Abstr. 8128 (1955). The mesomeric effect discussed in terms of a mixing of the "locally excited" ates of the hydrocarbon, and the "electron transfer" states. the substituent behaves as an electron donor, the energies the lowest electron transfer states can be estimated from e ionization potential of the substituent. A substituent which as a small ionization potential will be expected to exert a rong mesomeric effect, since the electron transfer states ve low energies. These states may give rise to new bands the spectrum. The spectrum of aniline is discussed in ese terms, and the band at 2350 A is attributed to an excitat- n to an electron transfer state. If the ionization potential is rge, then, in general, there will be only a weak mesomeric fect. In this case it is only possible to estimate the change energy of the lowest electronic states. A method is describ- l whereby the inductive effect can be allowed for, and this is plied to find the mesomeric effect of a methyl substituent om the various methylated benzenes. A.

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40. OBSERVATION OF CHEMICAL SHIFTS OF O^{17} UCLEI IN VARIOUS CHEMICAL ENVIRONMENTS. .E.Weaver, B.M.Tolbert and R.C.La Force.
chem. Phys., Vol. 23, No. 10, 1956-7 (Oct., 1955).

O^{17} nuclear magnetic resonance signals were observed ith natural O^{17} abundance and chemical shifts relative to $_2O$ are given for 15 compounds, the largest shift being that −6.9 gauss in 10 000 gauss for the NO_2^- ion. With non- uivalent O atoms, as in $C_2H_5ONO_2$ two distinct resonances e observed. D.H.Whiffen

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41. NUCLEAR QUADRUPOLE RESONANCES IN SOLID DINE COMPOUNDS. S.Kojima, K.Tsukada, S.Ogawa and Shimauchi.
chem. Phys., Vol. 23, No. 10, 1963 (Oct., 1955).

Quadrupole couplings and asymmetry parameters from adrupole resonances are given for ICl, I_2O_5, HgI_2 and NH_4I_3 d some resonance frequencies for $N(CH_3)_4I_3$, $N(CH_3)_4I_5$ and I_2. D.H.Whiffen

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42. NUCLEAR MAGNETIC RESONANCE SPECTRA OF ETHYL PYRIDINES. E.B.Baker.
chem. Phys., Vol. 23, No. 10, 1981-2 (Oct., 1955).

Chemical shifts and hyperfine splitting coefficients are ven for the proton resonance spectra of pyridine, the pico- es, lutidines and a collidine; the detailed patterns are in alitative agreement with expectation. D.H.Whiffen

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43. DIRAC VECTOR MODEL FOR ELECTRON COUPLED CLEAR SPIN INTERACTIONS. H.M.McConnell.
chem. Phys., Vol. 23, No. 12, 2454 (Dec., 1955).

Valence bond theory with the Dirac model is used to show at nuclear spins of non-neighbouring atoms (with zero ex- ange integral) can be coupled via three or more electron ins. The proton-proton coupling in H—C—H is calculated proximately to be of the correct order of magnitude. J.Hawgood

539.132

44. THE EFFECTS OF COVALENCY ON THE NUCLEAR AGNETIC RESONANCE IN IONIC CRYSTALS. K.Yosida d T.Moriya.
Phys. Soc. Japan, Vol. 11, No. 1, 33-49 (Jan., 1956).

Effects of covalency on the nuclear magnetic resonance ionic crystals are discussed on the basis of perturbation lculations. Formulae for the chemical shift, the I-I upling and the quadrupolar relaxation time are derived. sing the degree of covalency deduced from the experimental lues of the chemical shift, the coefficient of the I-I coupling d the quadrupolar relaxation time are estimated for some ionic crystals. It is shown that, when the degree of covalency is several per cent, the quadrupolar relaxation time becomes much shorter than in the pure ionic case. For instance, the relaxation time of Br in KBr, assuming a degree of covalency of 1%, is estimated to be 1 sec, which is only several times larger than the experimental value. A.

539.132

1445. DIPOLAR BROADENING OF THE CENTRAL LINE OF A MAGNETIC RESONANCE FOR HALF-INTEGRAL SPIN. K. Kambe and J.F.Ollom.
J. Phys. Soc. Japan, Vol. 11, No. 1, 50-2 (Jan., 1956).

The second moment of the central line of a magnetic resonance for half-integral spins, for which quadrupole coupling (nuclear spin case) or crystalline field effect (electronic spin case) is present, is calculated by the Van Vleck procedure. The interactions between like spins, unlike spins and semi-like spins are considered separately. The results are compared with the Van Vleck results for which no quadrupole coupling or crystalline effect is assumed. A.

539.132

1446. ON THE METHOD OF ATOMS IN MOLECULES. II. AN INTRA-ATOMIC CORRELATION CORRECTION. A.C.Hurley.
Proc. Phys. Soc. A., Vol. 69, Pt 1, 49-56 (Jan., 1956).

For Pt I, see Abstr. 3949 (1955). The method of atoms in molecules is modified in such a way as to overcome difficulties encountered in previous calculations. The modified theory is applied to two calculations on the ground state of the hydrogen molecule. The more accurate of the two modified calculations leads to an energy curve accurate to within 0.05 eV in the range 1 to 4 atomic units of the nuclear separation. A.

539.132

1447. SIMULTANEOUS CALCULATION OF POLARIZABILITY AND ELECTRONIC TRANSITION ENERGY OF MOLECULES. SPECIAL CASE OF ETHYLENE AND BENZENE. J.Barriol and J.Régnier.
J. Phys. Radium, Vol. 16, No. 8-9, 641-4 (Aug.-Sept., 1955). In French. (For previous part, see Abstr. 10407/1954).

The increment in polarizability of the ethylenic double bond is calculated with simple molecular orbitals and compared with those of the benzene ring. The value of longitudinal polarizability allows the evaluation of the wavelength corresponding to a parallel transition in C_2H_4. J.Jacobs

539.132

1448. INTERACTION ENERGY AMONG THREE HELIUM ATOMS. A.Shostak.
J. chem. Phys., Vol. 23, No. 10, 1808-13 (Oct., 1955).

Molecular orbitals made up of linear combinations of atomic orbitals, as well as orbital, total, and interaction energies, have been calculated for the linear configuration of three He 1-s atoms, with equal separation between the centre and each outer atom. Roothaan's self-consistent field matrix method was applied to this case. All electronic interactions were considered, their contributions appearing in the Hamiltonian used in solving for total energy. The assumption of additivity of the energies of all pairs of atoms in determining interaction energy is shown not to be valid for internuclear separations approaching collision diameter of the 1-s He atom, about 1 A. Deviation from additivity, as determined using the results of Wehner's MO calculation for the system He_2 is about 30% for the smallest internuclear separation considered, around 0.93 A. A.

539.132

1449. ELECTRONIC STRUCTURES OF TRANSITION-METAL COMPLEXES. L.E.Orgel.
J. chem. Phys., Vol. 23, No. 10, 1819-23 (Oct., 1955).

The empirically determined values of the parameter Dq, which in transition-metal complexes measure the influence of

the ligands on the metal d-orbitals, are interpreted theoretically. A quantitative treatment of "the magnetic criterion of the bond type," is given. Values of Slater–Condon parameters for transition metal ions are tabulated. A.

539.132

1450. ELECTRONIC POPULATION ANALYSIS ON LCAO-MO MOLECULAR WAVE FUNCTIONS. I. R.S.Mulliken.
J. chem. Phys., Vol. 23, No. 10, 1833-40 (Oct., 1955).

With increasing availability of good all-electron LCAO-MO (LCAO molecular orbital) wave functions for molecules, a systematic procedure for obtaining maximum insight from such data has become desirable. An analysis in quantitative form is given here in terms of breakdowns of the electronic population into partial and total "gross atomic populations", or into partial and total "net atomic populations" together with "overlap populations". "Gross atomic populations" distribute the electrons almost perfectly among the various AO's (atomic orbitals) of the various atoms in the molecule. From these numbers, a definite figure is obtained for the amount of promotion (e.g., from 2s to 2p) in each atom; and also for the gross charge Q on each atom if the bonds are polar. The total overlap population for any pair of atoms in a molecule is in general made up of positive and negative contributions. If the total overlap population between two atoms is positive, they are bonded; if negative, they are antibonded. Tables of gross atomic populations and overlap populations, also gross atomic charges Q, computed from SCF (self-consistent field) LCAO-MO data on CO and H_2O, are given. The amount of s-p promotion is found to be nearly the same for the O atom in CO and in H_2O (0.14 electron in CQ and 0.15e in H_2O). For the C atom in CO it is 0.50e. For the N atom in N_2 it is 0.26e according to calculations by Scherr. In spite of very strong polarity in the π bonds in CO, the σ and π overlap populations are very similar to those in N_2. In CO the total overlap population for the π electrons is about twice that for the σ electrons. The most easily ionized electrons of CO are in an MO such that the gross atomic population is 94% localized on the carbon atom; these electrons account for the (weak) electron donor properties of CO. A comparison between changes of bond lengths observed on removal of an electron from one or another MO of CO and H_2, and corresponding changes in computed overlap populations, shows good correlation. Several other points of interest are discussed. A.

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1451. ALTERNATIVE METHOD FOR CALCULATING SCF ORBITALS. H.Brion, R.Lefebvre and C.M.Moser.
J. chem. Phys., Vol. 23, No. 10, 1972 (Oct., 1955).

Theoretical. The iterative method of Abstr. 5573 (1955) has been applied to the determination of many-determinant wave functions, and to odd alternant hydrocarbons (allyl, pentadienyl). A case of the former type, the ^1B_u and ^3B_u states of trans-butadiene, represented with two singly-occupied orbitals, gives final SCF orbitals related in pairs, like the ground-state orbitals. J.Hawgood

539.132

1452. ON THE SEMIEMPIRICAL TREATMENT OF THE PI ELECTRONS OF SOME HALOGEN SUBSTITUTED BENZENES. R.H.Knipe.
J. chem. Phys., Vol. 23, No. 11, 2089-96 (Nov., 1955).

The π moments of some halogen-substituted benzenes have been estimated from measured moments and compared to the predictions of a semiempirical molecular orbital theory of the π-electrons. Using parameters suggested by a perturbation treatment of these molecules, the results of two previous semiempirical molecular orbital treatments considering different molecular properties are compared with each other and with the estimated π moments. The agreement is in general found to be good. A

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1453. SOME SEMIEMPIRICAL QUANTUM-MECHANICAL CALCULATIONS FOR AMMONIA AND FOR DIIMIDE.
G.W.Wheland and P.S.K.Chen.
J. chem. Phys., Vol. 24, No. 1, 67-70 (Jan., 1956).

Quantum-mechanical calculations by the naive, semiempirical LCAO MO method have been made for the ammonia a the diimide molecules. With the use of parameters obtained by fitting the empirical data for ammonia, it has been calcula ted that the activation energy for the syn-anti interconversio of diimide should be about 33 kcal per mole. A

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1454. MOLECULAR ORBITAL THEORY OF THE RELATIVE REACTIVITIES OF SUBSTITUTED AROMATIC MOLECULES TOWARDS RADICAL ADDITION. H.H.Greenwood.
Nature (London), Vol. 176, 1024-5 (Nov. 26, 1955).

It is shown that recent experimental results (Fahrenhors and Kooyman, 1955) on the relative reactivities of substitute anthracenes towards radical attack bear out the relationship found by the author, viz. that the change in free valence δF_r in passing from a parent alternant hydrocarbon to the monosubstituted derivative is an even function of the electronegativity of the substituent group. They also bear out, but for one anomaly, the work of Hey and Williams (1953) on radical attack upon C_6H_6 derivatives. The anomaly relating to pyridine is explained. F.Lachma

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1455. CONCERNING HYDROGEN POSITIONS IN AQUO-COMPLEXES — $CuCl_2.2H_2O$. R.E.Rundle, K.Nakamoto and J.W Richardson.
J. chem. Phys., Vol. 23, No. 12, 2450-1 (Dec., 1955).

The infrared spectrum of single crystals of $CuCl_2.2H_2O$ was measured (by observing the polarization of the HOH ben ing mode) to determine the ionic-covalent character of the H_2O—Cu bond. This shows it is mainly covalent, and elimi ates the ionic form with the water dipole pointing at the cati usually assumed in crystal field theory. The tetrahedral Cu—O—H angles are distorted towards the ionic model ang by H bonding, O—H...Cl. This covalent Cu—O is inconsist ent with theories of magnetic behaviour depending on an unpaired 3d electron in Cu. J.Hawgoo

539.133 : 535.3

1456. VIBRATIONAL INTENSITIES IN HALOGENATED METHANES. I. METHYLENE CHLORIDE. J.W.Straley.
J. chem. Phys., Vol. 23, No. 11, 2183-6 (Nov., 1955).

The absolute infrared absorption intensities of four fundamental bands in CH_2Cl_2 have been measured in the vapour state. The intensities that have been observed are (in c/s a NTP): A_8 (CH stretching) = 48.0×10^{10}; A_7 (CH rocking) = 13.0×10^{10}; A_3 (CCl stretching) = 1420.0×10^{10}; A_9 (CCl rock ing) = 375.0×10^{10}. These data indicate that the bond moments and bond derivatives are (in e.s.u.): μ (CH) = $+0.45 \times 10^{-18}$; μ(CCl) = -0.95×10^{-18}; $\partial\mu(CH)/\partial r(CH) = +0.3 \times 10^{-10}$ or -0.2×10^{-10}; $\partial\mu(CCl)/\partial r(CCl) = +3.7 \times 10^{-10}$. It was no possible to resolve the ambiguity in signs that lead to the alternate values of $\partial\mu(CH)/\partial r(CH)$. A

539.13

1457. STRUCTURE OF HEXAMETHYLDISILANE.
H.Murata and K.Shimizu.
J. chem. Phys., Vol. 23, No. 10, 1968-9 (Oct., 1955).

Fundamental frequencies were calculated for the ethane-like molecule treating the methyl groups as particles. Tetrahedral angles were assumed and bond lengths Si—Si = 2.34 A. Si—CH_3 = 1.90 A. It is concluded that the equilibrium config ration is of D_{3h} or D_{3d} symmetry. J.Jacob

539.1

1458. HYBRID π ORBITALS AND PARTIAL DOUBLE BON CHARACTER IN COVALENT COMPLEXES. G.Giacometti.

. chem. Phys., Vol. 23, No. 11, 2068-73 (Nov., 1955).

Angular parts of p- and d-orbitals are hybridized to form set of tetrahedrally oriented π orbitals. These orbitals are uitable for explaining partial double bond character in compounds such as nickel tetracarbonyl. It is shown that up to ree of these orbitals may exist, each possessing the required roperties of orthogonality and linear independence. The maxnum partial double bond character allowed is, in this way, 5%. The strength of these orbitals, according to a modified auling's criterion, is discussed. Also the cases of trigonal pyramidal and octahedral symmetry are discussed. An tempt is made to interpret semiquantitatively bond lengths . Cr, Fe, and Ni carbonyls. A.

539.133 : 535.343

59. NOTE ON THE INTERACTION AND CONFIGURATION N CHLORINE–BENZENE COMPLEX. H.Murakami.
chem. Phys., Vol. 23, No. 10, 1957-8 (Oct., 1955).

Theoretical. Criticizes the charge-transfer interpretaon of the shift of the Cl–Cl frequency from 557 cm^{-1} for free l_2 to 526 cm^{-1} in benzene solution (Abstr. 3587, 3588, /1955). he van der Waals interactions could also explain the shift, nd excited asymmetric van der Waals configurations of ngle Cl_2–benzene complex are more likely than higher harge-transfer structures. The asymmetry required for frared activity may be caused by the packing condition of fferent complex units rather than by asymmetry of configuraon within individual units. J.Hawgood

539.133

60. CONFIGURATION OF POLYMER MOLECULES WITH XCLUDED VOLUME. W.R.Krigbaum.
chem. Phys., Vol. 23, No. 11, 2113-21 (Nov., 1955).

The displacement distribution for a polymer with excluded plume is derived by rejecting the unacceptable configurations vailable to random-flight chains. The fraction of those conurations corresponding to a displacement length L which are ceptable is calculated through use of a model which considers e chain to be composed of a sequence of identical subchains. teractions between the elements of a given subchain, and tween these and elements of the various possible clusters adjacent subchains, are summed to obtain the total interrence for all elements of the chain. The average interference countered by the elements of one subchain is calculated erefrom. The resulting displacement distribution is conderably sharper than the corresponding Gaussian distribution r positive values of the excluded volume, but somewhat more tended than the corresponding Gaussian for negative excluded volumes. When the present treatment is compared with at of Flory, the former predicts smaller values for the ean-square displacement length, $\langle L^2 \rangle$, at both the low and e high ends of the molecular weight scale, and a more arked dependence of $\langle L^2 \rangle$ upon the thermodynamic interions as embodied in the factor $(\frac{1}{2} - \chi_{12})$. Comparison th experiment confirms these predictions, and indicates the esent treatment to be a significant improvement over that oposed earlier by Flory. A.

539.133 : 548.7 : 536.4

61. THE CROSS-CHAIN CONFIGURATION AND A NEW YPE OF PHASE TRANSFORMATION IN SOLID LONG CHAIN CID AMIDES. T.Sakurai.
Phys. Soc. Japan, Vol. 10, No. 12, 1040-8 (Dec., 1955).

From the X-ray investigation on the single crystal of ng-chain acid amides of even carbon number from C = 10 to , three phases are found to exist. Phase A in palmitic, yristic and capric acid amides has an unusual crossed-chain nfiguration similar to that found in potassium soaps. In ase B, found in palmitic and stearic acid amides, and phase in stearamide under a special condition, chains are paral- as in the ordinary long-chain compounds. All phases seem be stable at room temperature, but phase A of palmitic ide transforms irreversibly into phase B by heating. But the basal plane is almost unchanged during the transformation. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

1462. ISOTOPE SPIN AND THE LEVELS OF LIGHT NUCLEI. A.Baz' and Ya. Smorodinskiĭ.
Uspekhi fiz. Nauk, Vol. 55, No. 2, 215-64 (1955). In Russian.

Following an account of the theory of the subject the paper gives a 25-page summary of current information on the levels of light nuclei for which A is 50 or under, i.e. He^4, Li^4, H^4; .....Ti^{50}, V^{50}, Cr^{50}. This section is plentifully provided with sketches illustrating the comparative arrangement of levels in isobars and the magnitude of isotope spin in nuclei. The survey does not exhaust all known material and is admittedly not free from some arbitrariness in the identifications. C.R.S.Manders

539.152.1

1463. FAST E2 TRANSITION PROBABILITIES FROM COULOMB EXCITATION. G.M.Temmer and N.P.Heydenburg.
Phys. Rev., Vol. 99, No. 5, 1609-12 (Sept. 1, 1955).

Summary of experimental results on the positions and lifetimes of the first excited (2^+) states of even-even nuclei for $60 \leq Z \leq 90$ (strong coupling region) and $22 \leq Z \leq 48$ (weak coupling region). The results were obtained from studies of thin-target alpha-particle excitation functions as well as some thick-target excitation-functions for $E\alpha$ up to 7 MeV, and are compared with those of experiments on direct lifetime determinations and on resonance fluorescence. A.O.Stanesby

539.152.1

1464. CLASSIFICATION OF THE NUCLEONIC STATES IN DEFORMED NUCLEI. B.R.Mottelson and S.G.Nilsson.
Phys. Rev., Vol. 99, No. 5, 1615-17 (Sept. 1, 1955).

Nuclear distortions are attributed to centrifugal pressure exerted by individual nucleons. These deformations in turn modify the nucleonic motion. Nucleonic states in the deformed nuclei in the region of A between 150 and 194 are classified and equilibrium deformations calculated from ground state configurations. P.T.Matthews

539.152.1

1465. NUCLEAR HARTREE–FOCK CALCULATIONS. M.Rotenberg.
Phys. Rev., Vol. 100, No. 1, 439-40 (Oct. 1, 1955).

These were carried out for N = Z = 92 with a square well as zero-order potential and with various mixtures of direct and space-exchange interactions of Gaussian or Yukawa type. (Ranges 2 and 1.4×10^{-13} cm and self-consistent strengths 55.6 and 35.6 MeV, respectively.) The latter gave a slightly larger and more diffuse density distribution. W.J.Swiatecki

539.152.1

1466. ON A NEW METHOD OF OBTAINING THE ROTATIONAL NUCLEAR LEVELS. C.Marty.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 855-7 (Oct. 3); No. 15, 928-9 (Oct. 10); No. 17, 1112-13 (Oct. 24, 1955). In French.

In these three papers it is shown that the general properties of a system consisting of a core strongly coupled to N nucleons, are sufficient to explain the rotational levels, without specifying precisely the nucleon orbitals. The method is applicable whether or not the core has an axis of symmetry. P.T.Matthews

539.152.1

1467. FIRST EXCITED STATE OF Mn^{55}. E.M.Bernstein

and H.W.Lewis.
Phys. Rev., Vol. 100, No. 5, 1367-8 (Dec. 1, 1955).

The spin of the first excited state of Mn^{56} at 128 keV has been measured in the electric excitation process with 3 MeV alpha-particles. Determinations of the K conversion coefficient and the angular distribution of the gamma-rays lead to a spin assignment of $7/2^-$ for the excited state and multipolarity M1 for the transition to the ground state. The K conversion coefficient ($\alpha_K = 0.0144 \pm 0.003$) was measured by comparison with the known coefficient of the 137 keV transition in Ta^{181}. The spin, parity and transition probability are consistent with those expected for a rotational state. A.

539.152.1

1468. RADIATIONS FROM 1^- STATES IN EVEN-EVEN NUCLEI. F.S.Stephens, Jr, F.Asaro and I.Perlman.
Phys. Rev., Vol. 100, No. 5, 1543-5 (Dec. 1, 1955).

See Abstr. 2073 (1955). Measurements of the decay gamma-ray intensities indicate that the 1^- states belong to the ground-state (K = 0) configuration. The alpha-groups, from the parent nuclei, leading to the 1^- states appear to be hindered by factors varying from 4 to 1000. J.J.Wilkins

539.152.1

1469. NOTE ON THE T = ⅗ STATE IN N^{15}. G.A.Bartholomew, A.E.Litherland, E.B.Paul and H.E.Gove.
Canad. J. Phys., Vol. 34, No. 1, 147 (Jan., 1956).

The recently reported Q-value (−0.96 MeV) for the $C^{14}(d, p)C^{15}$ reaction makes it seem probable that the T = ⅗ state in N^{15} (spin ½+) which appears at excitation 11.61 MeV in the reaction $C^{14}(p, \gamma)N^{15}$ (Abstr. 9071/1955) corresponds to the ground state of C^{15} rather than an excited state; the ground state of C^{15} would then be ½+. A.O.Stanesby

539.152.1

1470. QUANTUM CALCULATION OF COULOMB EXCITATION. II. QUADRUPOLE EXCITATION: NUMERICAL RESULTS. L.C.Biedenharn, M.Goldstein, J.L.McHale and R.M.Thaler.
Phys. Rev., Vol. 101, No. 2, 662-8 (Jan. 15, 1956).

The formal methods for the quantum mechanical treatment of Coulomb excitation discussed in Pt I, (Abstr. 554/1956) are applied to obtain numerical results for the electric quadrupole case. Tables of the excitation function and the directional correlation parameters are presented and discussed for a wide range of their arguments. A.

539.152.1 : 539.164.2

1471. ON THE QUESTION OF ROTATIONAL LEVELS AND THE SPECTRA OF HEAVY NUCLEI. II. S.G.Rÿzhanov.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 247-9 (1955). In Russian.

See Abstr. 5670(1953), 8553(1954). Level schemes and intensities of α-groups are analysed using a nuclear model in which the closed shells of the nucleus form rotators and the outer particles have an individual-particle level scheme. The scheme ThC $\xrightarrow{\alpha}$ ThC'' is considered in detail. G.E.Brown

539.152.2

1472. THE MAGNETIC MOMENT OF THE 480 keV LEVEL OF Ta^{181}. E.Heer, R.Rüetschi and P.Scherrer.
Z. Naturforsch., Vol. 10a, No. 11, 834-8 (1955). In German.

A summary of the theory underlying measurements of nuclear moments by a study of $\gamma - \gamma$ correlations in a magnetic field, followed by an account of measurements on the 132-480 keV cascade in Ta^{181}. The gyromagnetic ratio of the 408 keV level was determined as $g = 1.30 \pm 0.07$. Assuming a spin I = ⅝, the magnetic moment becomes $\mu = (3.25 \pm 0.17)$ n.m. W.J.Swiatecki

539.152.2

1473. TABLES OF NUCLEAR MOMENTS. E.F.Kyul'ts, V.V.Kunts and V.G.Khartman.
Uspekhi fiz. Nauk, Vol. 55, No. 4, 538-93 (1955). In Russia

In compiling these tables the authors have based themselves mainly on work reviewed in Physics Abstracts up to Sept., 1954. Tables consist of nuclear moments with indicat-ions of method of measurement and accuracy. Work on the topic published after J.E. Mack's survey of 1950 (Abstr. 6685/1950) is also given with the exception of those cases whe the moments have been obtained by nuclear reactions and in these cases there are indicated merely one or two papers con taining references to earlier work. 500 + references. C.R.S.Manders

539.152.

1474. MAGNETIC MOMENTS OF LIGHT NUCLEI. F.J.Wiśniewski.
Nuovo Cimento (Ser. 10), Vol. 2, No. 2, 323-6 (Aug., 195
In French.

Extension of Abstr. 2680 (1954) to consider the magnetic moments of nuclei on an annular model; theoretical and experimental results are compared. A.O.Stanesb

539.152.

1475. MAGNETIC MOMENT OF AN EXCITED STATE OF THE FLUORINE-19 NUCLEUS. P.B.Treacy.
Nature (London), Vol. 176, 923-4 (Nov. 12, 1955).

From the anisotropy of the gamma-ray emission as a function of magnetic field, $g = +1.35 \pm 0.35$ is obtained for F^{19} of lifetime 1.0×10^{-7} sec and excitation energy 197 keV. D.H.Whiffe

539.152.

1476. RELAXATION TIMES IN MAGNETIC RESONANCE D.Pines and C.P.Slichter.
Phys. Rev., Vol. 100, No. 4, 1014-20 (Nov. 15, 1955).

Line-widths and relaxation times in magnetic resonance are discussed via a random walk model which is derived by a simple argument. Using the result, various topics in nuclea resonance and in conduction-electron spin resonance are dis-cussed. The physical basis for the effect of motion in narro ing resonance lines is clearly evident, and a simple picture presented of the electron relaxation processes analysed by Overhauser. A

539.152.

1477. NUCLEAR SPIN OF POLONIUM-209 (Po^{209}). K.L.Vander Sluis and P.M.Griffin.
J. Opt. Soc. Amer., Vol. 45, No. 12, 1087 (Dec., 1955).

Hyperfine structure for Po^{209} was investigated using an electrodeless discharge (2450 Mc/s) and a Fabry-Perot inter ferometer with a 21 ft grating. The results are consistent with a nuclear spin of ⅝, and are briefly described. J.D.Cragg

539.152 2 : 536.7

1478. THERMODYNAMICS OF IRREVERSIBLE PROCESSE AND THE OVERHAUSER NUCLEAR POLARIZATION EFFEC W.A.Barker and A.Mencher.
Phys. Rev., Vol. 100, No. 4, 1224-5 (Nov. 15, 1955).

539.152.2 : 538.22

1479. HYPERFINE STRUCTURE OF PRASEODYMIUM. J.M.Baker and B.Bleaney.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 936-7 (Oct., 1955).

The paramagnetic electron resonance of Pr ethyl sulphat diluted with yttrium is interpreted in terms of a Hamiltonian with parameters $g_Z = 1.525 \pm 0.02$, $A_Z = 0.0755 \pm 0.002$ cm^{-1}, I = 5/2. These give $\mu_n = 3.92 \pm 0.2$ n.m. after correction and using $\langle r^{-3} \rangle = 37 \pm 2$ A^{-3}. D.H.Whiffe

539.152.2 : 538.2

1480. NUCLEAR MOMENTS OF THE LANTHANONS FRO PARAMAGNETIC RESONANCE. B.Bleaney.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 937-9 (Oct., 1955).

Based on the spin-orbit coupling energies of the trivalent ıre earth ions which are fitted empirically by = 5.46(Z - 47)^2 cm^{-1}, $\langle r^{-3} \rangle$ is calculated for these ions. rom the known paramagnetic resonance hyperfine structure e nuclear moments are calculated to be: Pr^{141}, 3.9; d^{143}, 1.03; Nd^{145}, 0.64; Sm^{147}, 0.83; Sm^{149}, 0.68; Tb^{159}, 1.52: o^{165}, 3.31; Er^{167}, 0.48; Yb^{171}, 0.49; Yb^{173}, 0.68 n.m.
D.H.Whiffen

539.152.2 : 539.165.2

481. A NOTE ON THE SPIN AND PARITY OF 2.69 DAY Au^{198}. L.G.Elliott, M.A.Preston and J.L.Wolfson.
anad. J. Phys., Vol. 33, No. 10, 607-8 (Oct., 1955).
A re-analysis of earlier experimental results (Abstr. 798/1954) on the shape of the 1371 keV beta-transition of Au^{198} to the ground state of Hg^{198}, using recent more accurate alues of the shape factor, shows that the assignment of spin nd parity 2, –(or 3, –) to the 2.69 day state of Au^{198} is con- istent with the spectral shape. A.O.Stanesby

539.153

482. ON THE PROBLEM OF A GENERALIZATION OF HE STATISTICAL THEORY OF THE ATOM. L.P.Rapoport. h. eksper. teor. Fiz., Vol. 29, No. 3(9), 376-7 (1955). In ussian.
The statistical theory is generalized to include some rela- vistic corrections and a spin-orbit force. G.E.Brown

539.153

483. THE TWO-CONFIGURATIONAL APPROXIMATION J THE CASE OF ATOMS OF THE TYPE OF CARBON. .B.Bolotin, I.B.Levinson and L.I.Levin.
h. eksper. teor. Fiz., Vol. 29, No. 4(10), 449-53 (1955). Russian.
The atoms C, N^+, O^{++}, F^{3+}, Ne^{4+} are studied by means of e configurations $1s^2\,2s^2\,2p^2$, $1s^2\,2s\,2p^3$ and $1s^2\,2p^4$ uilt up out of one-electron wave functions. The first and ird configurations are strongly mixed, and these are em- oyed in a two-configurational approximation. The dipole rengths and transition probabilities are calculated for the ansitions $1s^2\,2s\,2p^3 - 1s^2\,2s^2\,2p^2$. G.E.Brown

539.153

484. ALIGNMENT IN SODIUM VAPOUR. J.Margerie, Brossel and A.Kastler.
.R. Acad. Sci. (Paris), Vol. 241, No. 5, 474-6 (Aug. 1, 955). In French.
With Na atoms in a magnetic field below 40 gauss and uminated with natural Na D light, the states of greatest |m| come the most populated, but with finite magnetic fields ere is asymmetry between + m and – m due to I, J uncoup- ng. The degree of alignment is observed from the polarizat- n of the emitted light as a function of field when a 14.47 Mc/s f. field induces different Δ m transitions in the ground state the static field is varied. Theory and experiment are in reement. D.H.Whiffen

539.153

485. SPATIAL EXTENSION OF THE PROTON MAGNETIC OMENT FROM THE HYPERFINE STRUCTURE OF HYDRO- EN. W.M.Moellering, A.C.Zemach, A.Klein and F.E.Low. hys. Rev., Vol. 100, No. 1, 441-2 (Oct. 1, 1955).
The largest uncertainty in the hyperfine structure formu- is a term depending on the proton structure. With a value α from the fine structure measurement, the hyperfine form- a can be evaluated except for this term; comparison with xperiment yields limits on the magnitude of the term.
G.E.Brown

539.153

486. INCREASE OF THE STRENGTH OF ATOMIC ORIEN- ATION IN SODIUM VAPOUR IN THE PRESENCE OF HYDRO- EN. J.Brossel, J.Margerie and A.Kastler.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 865-7 (Oct. 3, 1955). In French.
The presence of up to 0.2 mm of H_2 in the experiment detecting ground state resonance transitions in Na by optical means (Abstr. 2084/1955) decreases the total signal by adding to the quenching of the excited state, but it markedly increases the signal relative to a constant light emission intensity. The decreased Na diffusion rate means that more atoms undergo the double excitation while in the light beam. D.H.Whiffen

539.153

1487. REDETERMINATION OF THE HYPERFINE SPLIT- TINGS OF HYDROGEN AND DEUTERIUM IN THE GROUND STATE. P. Kusch.
Phys. Rev., Vol. 100, No. 4, 1188-90 (Nov. 15, 1955).
The hyperfine splittings of hydrogen and deuterium in the $1^2S_{1/2}$ state have been remeasured by the atomic beam method. It is found that

$$\Delta\nu(H) = (1420.405\,73 \pm 0.000\,05) \times 10^6 \text{ sec}^{-1},$$
$$\Delta\nu(D) = (327.384\,302 \pm 0.000\,030) \times 10^6 \text{ sec}^{-1}.$$

The result for hydrogen is in agreement with a recent measure- ment of Wittke and Dicke. It is in significant disagreement with an earlier atomic beam measurement. A.

539.153 : 539.152.1

1488. EFFECT ON X-RAY FINE STRUCTURE OF DEVIA- TIONS FROM A COULOMB FIELD NEAR THE NUCLEUS. A.L.Schawlow and C.H.Townes.
Phys. Rev., Vol. 100, No. 5, 1273-80 (Dec. 1, 1955).
Deviations from a Coulomb field near the nucleus of very heavy atoms appear to produce changes as large as about one part in 400 on the fine structure splitting of the 2 p electronic level. Theoretical evaluation of these changes is discussed and available X-ray data analysed to yield an experimental determination of their magnitude. A nuclear radius as large as $2 \times 10^{-13}\ A^{1/3}$ cm must be assumed if the observed effects come only from deviations in the Coulomb field due to the finite nuclear size. The preferred interpretation is that most of the contribution to the observed change in fine structure comes from quantum electrodynamic effects (Lamb shift) which produce deviations from a Coulomb field near the nucleus. This appears to provide a method for study of the Lamb shift for large Z and possibly also of nuclear size. A.

539.153 : 539.18

1489. ENERGY LEVELS OF MU-MESIC ATOMS. S.M.Shah.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 945-6 (Oct., 1955).
A charge density corresponding to negative charge at the centre and to positive charge in the outer region is employed.
G.E.Brown

539.153.4

1490. SOLUTION OF THE EQUATION OF THE STATISTICAL ATOM GENERALIZED FOR CORRELATION IN THE CASE OF PRESSURES DIFFERENT FROM ZERO. P.Gombas.
Acta phys. Hungar., Vol. 5, No. 1, 123-9 (1955). In German.
Solutions are given for the noble gases Ne, Ar, Kr, and X; for the positive alkali ions Na^+, K^+, Rb^+ and Cs^+; and for the negative halogen ions F^-, Cl^-, Br^- and J^-. G.E.Brown

539.153.4

1491. SELF-CONSISTENT FIELD OF FOCK IN THE TWO- CONFIGURATIONAL APPROXIMATION FOR BORON. I.I.Glembotskiĭ, V.V.Kibartas and A.P.Yutsis.
Zh. eksper. teor. Fiz., Vol. 29, No. 5(11), 617-22 (1955). In Russian.
The two configurations $1s^2\,2s^2\,2p$ and $1s^2\,2p^3$ are employed in solving the Hartree equations for wave functions and energy. Inclusion of the second configuration removes about a third of the discrepancy between the one-configurational result and experiment. G.E.Brown

539.153.4

1492. ON THE APPROXIMATE THOMAS–FERMI FUNCTION FOR A COMPRESSED NEUTRAL ATOM. T.Tietz.
Nuovo Cimento (Ser. 10), Vol. 2, No. 2, 327-9 (Aug., 1955).

This function $\Phi(x)$ is derived in the same way as in Abstr. 9523 (1954) but using the author's approximate solution for the free atom: $\Phi_0 = (1 + ax)^{-2}$ instead of Kerner's $(1 + ax)^{-1}$. W.J.Swiatecki

539.153.4

1493. SYSTEMATIC APPROXIMATIONS IN THE SOLUTION OF SCHRÖDINGER'S EQUATION FOR ATOMS WITH TWO ELECTRONS. I. PRINCIPLE OF THE METHOD. SYMMETRICAL S-STATES. P. Pluvinage.
J. Phys. Radium, Vol. 16, No. 8, 675-80 (Aug.-Sept., 1955). In French.

The use of the variables $s = r_1 + r_2$, r_{12}/s, $(r_1 - r_2)/s$, reduces the numerical solution of the equation under consideration to that of an infinite system of linear homogeneous differential equations. The eigenvalues are, in absolute value, the squares of the roots of the determinant of the doubly infinite system of linear homogeneous equations equivalent to the differential system. A formal development is obtained for the wavefunctions, but its convergence is not proved. However, the convergence of the numerically calculated value towards the experimental value is fairly rapid in the case of the ground state of He I. The method appears suitable for automatic computing. L.Pincherle

539.153.4

1494. α^3 CORRECTIONS TO THE GROUND STATE OF HELIUM. R.O.A.Robinson.
Canad. J. Phys., Vol. 33, No. 11, 707 (Nov., 1955).

Calculations following the formalism of Abstr. 7708/1955 indicate that these are negligible. G.E.Brown

539.153.4

1495. WAVE FUNCTIONS AND TRANSITION PROBABILITIES FOR LIGHT ATOMS. H.Yilmaz.
Phys. Rev., Vol. 100, No. 4, 1148-53 (Nov. 15, 1955).

A new method of taking electronic correlations into account is presented. This method differs from conventional configuration methods in its generality, simplicity and interpretation. However, due to the particular choice of perturbation series, there are substantial similarities. The computation is based on a function, the S-function, which was tabulated beforehand. This function is a bilinear Laplace transform of the Green's function and has various useful properties. The method is applied to the $(1s^2 2s^2 2p^2)$ configuration of C I, N II, O III and F IV. A few significant terms are identified which take care of 60-80% of the discrepancy between experimental and theoretical values of multiplet separations. The spin-orbit separations and nebular transitions are calculated. With a slight modification of the 2p wave-function it is seen that substantial agreement with experiment can be obtained. A.

539.153.4

1496. ORBIT–ORBIT INTERACTIONS IN ATOMIC l^n CONFIGURATIONS. S.Yanagawa.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1029-32 (Dec., 1955).

A simplified expression for the orbit–orbit interactions in terms of scalar products of tensor operators is derived for l^n configurations by use of the method of Racah. The main contribution of the interactions is given in the form $-\beta L(L + 1)$, β being a positive constant. Analyses are made for $4p^2$ and $5p^4$ configurations of GeI, AsII and TeI by taking the effects of the orbit–orbit interactions into account. The agreement between theoretical and experimental values of terms are satisfactory for GeI and AsII. A.

539.153.4

1497. SCREENING COEFFICIENTS FOR THE DEEP LEVELS OF HEAVY ATOMS (Z GREATER THAN 60). W.Laskar.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1753-5 (Dec. 14, 1955). In French.

Coefficients calculated by the Thomas–Fermi statistical method are compared with values deduced from experimental measurements. N.M.King

539.153.4

1498. ELECTRON CORRELATION. J.E.Mayer.
Phys. Rev., Vol. 100, No. 6, 1557-86 (Dec. 15, 1955).

The state of a real gas of electrons of uniform density is examined. An equation for the coordinate representation of the density matrix for two particles is found which satisfies the various necessary conditions and which gives a lower energy than the antisymmetrized Single Slater Determinant. The additional negative correlation energy found is proportional to the one-sixth power of the density at high densities. A.

539.155.2 : 539.172.4

1499. SCINTILLATION COUNTING OF THE (n,α) OR (n,f) REACTION FOR THE ISOTOPIC ANALYSIS OF LITHIUM, BORON AND URANIUM. H.Wänke and E.U.Monse.
Z. Naturforsch., Vol. 10a, No. 9-10, 667-9 (1955). In German.

Infinitely thick samples were irradiated by thermal neutrons from a RaBe source in paraffin, and the tritons, alpha-particles or fission fragments emitted detected with a ZnS screen and photomultiplier. The counting rates and backgrounds, for the particular geometry used and samples of normal isotopic abundances, are given. Specimen results are given for the determination of the abundance of Li^6 in electrolytically depleted LiF by this method. J.Hughes

539.155.4

1500. CONCERNING THE MASSES OF THE STABLE ZINC ISOTOPES. J.T.Kerr, N.R.Isenor and H.E.Duckworth.
Z. Naturforsch., Vol. 10a, No. 11, 840-3 (1955).

The masses of Zn^{64}, Zn^{66}, Zn^{67} and Zn^{68} have been studied mass spectroscopically by means of the O_2^{16}–$\frac{1}{2}Zn^{64}$, $\frac{1}{2}Xe^{132}$–Zn^{66}, $\frac{1}{2}Xe^{134}$–Zn^{67} and $\frac{1}{2}Xe^{136}$–Zn^{68} doublets. These studies suggest that the currently accepted masses of Zn^{64} and Zn^{66} are too large by about 0.4 mMU. If these revisions are made several existing discrepancies between transmutation and mass data disappear. A.

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16 .17

1501. NUCLEAR PHYSICS. A.E.S.Green.
London: McGraw-Hill Publishing Company (1955) xv + 535 pp.

Review in Nature (London), Vol. 176, 1088-9 (Dec. 10, 1955): "...though requiring more from the student and covering less ground," (than the book reported in the preceding abstract.) "is able to provide the necessary discussion of the more difficult topics treated in a purely descriptive fashion by Dr. Kaplan".

539.16 .17

1502. NUCLEAR PHYSICS. I.Kaplan.
Cambridge, Mass.: Addison-Wesley Publishing Company (1955) xi x 609 pp.

Review in Nature (London), Vol. 176, 1088-9 (Dec. 10, 1955). "...ideal for those whose work in neighbouring fields (reactor engineering and radiochemistry for example) brings them in close contact with nuclear physics, and for many physics students."

539.16

1503. ARTIFICIAL RADIOACTIVITY AND PHYSICS. O.R.Frisch.
J. Phys. Radium, Vol. 16, No. 10, 748-53 (Oct., 1955) In French.

It is shown how the discovery of artificial radioactivity produced a broadening of the field of physics and in particular led to the development of the theory of β -decay and recent nuclear models. J.Hughes

539.16.08

1504. COMPARISON OF BRITISH AND UNITED STATES NATIONAL RADIUM STANDARDS. W.E.Perry.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 942-44 (Oct., 1955).

The comparison was made in 1952 at the N.P.L. by 3 methods: (1) ionization chamber and gold-leaf electroscope, (2) ionization chamber and Lindemann electrometer (null) method, (3) G.M. counter. See also Abstr. 3992 (1955) for results of a similar comparison made at N.B.S. J.Hughes

539.16.08

1505. APPLICATIONS OF RADIOACTIVE ISOTOPES TO MEASUREMENTS. R.T.Nieset.
Science, Vol. 122, 742-5 (Oct. 21, 1955).

A brief survey of the methods of detecting nuclear radiations and of radioactive tracer techniques. J.M.Hough

539.16.08

1506. INTERNATIONAL COMPARISONS OF RADIOACTIVITY STANDARDS. A.V.Astin, E.C.Bullard and W.B.Lewis.
Nature (London), Vol. 177, 12-13 (Jan. 7, 1956).

Brief survey of comparisons made on Na^{24}, P^{32}, Co^{60}, $Sr^{90} + Y^{90}$, I^{131} and Au^{198}, during the period May 1952 to November 1954. The organizations taking part are listed and references given to 12 papers on the work.

539.16.08 : 539.163.1

1507. ON A NEW METHOD OF STUDYING RADIOACTIVE PHENOMENA: NUCLEAR CINEMATOGRAPHY. APPLICATION TO THE MEASUREMENT OF THE LIFETIME OF RaC'. THE POSSIBILITY OF ITS UTILIZATION IN THE DETERMINATION OF THE PERIODS OF ARTIFICIAL RADIOELEMENTS. M.Laporte.
J. Phys. Radium. Vol. 16, No. 11, 817-23 (Nov., 1955). In French.

A source of radium C' is deposited onto the periphery of a moving disk which then passes under a nuclear emulsion plate. By observing the exponential decrease in the density of observed tracks on narrow bands perpendicular to the direction of motion, it is possible to deduce the lifetime of the radium C' and it has been determined to be 1.5×10^{-4} sec. A generalization of the method is discussed to the determination of the periods of artificially radioactive elements; it appears especially suitable in the range of T between 10^{-2} and 10^{-4} sec. D.J.Prowse

539.163

1508. NUCLEAR LEVELS OF Lu^{175}. J.P.Mize, M.E.Bunker and J.W.Starner.
Phys. Rev., Vol. 100, No. 5, 1390-6 (Dec. 1, 1955).

The negatron decay of Yb^{175} (4.2 day) and orbital electron capture decay of Hf^{175} (70 day) to Lu^{175} have been investigated in detail using a magnetic lens spectrometer, 180^0 permanent magnet spectrographs, scintillation spectrometers and coincidence techniques. Eleven gamma-transitions in Lu^{175} of the following energies and indicated multipolarities have been observed: 89.3 (M1 + E2). 113.6 (M1 + E2), 137.6, 144, 229.3 (E2), 251, 282.4 (E1 + M2), 318.6, 342.9 (M1 + E2), 396.0 (E1 + M2) and 432.2 keV. On the basis of these measurements, consistent decay schemes for Yb^{175} and Hf^{175} are proposed. Observed nuclear levels in Lu^{175} excited by the radioactive decay of these two nuclides occur at 113.6, 251.2, 342.9, 396.0 and 432.2 keV and are assigned spin and parity values 9/2+, 11/2+, 5/2+, 9/2– and 5/2+, respectively. The levels at 113.6 keV and 251.2 keV constitute a rotational band whose base state occurs at stable Lu^{175} (7/2+). A.

539.163

1509. RADIATIONS FROM THE ACTIVE ISOTOPES OF YTTERBIUM. J.M.Cork, M.K.Brice, D.W.Martin, L.C.Schmid and R.G.Helmer.
Phys. Rev., Vol. 101, No. 3, 1042-6 (Feb. 1, 1956).

By using Yb of high purity (99.8%) irradiated in the maximum flux of the Argonne pile and studied by scintillation and magnetic photographic spectrometers, a re-evaluation of the energies of the radiations has been made. Several previously unreported gamma-rays are found and nuclear level schemes for Tm^{169}, Lu^{175} and Lu^{177} are proposed. Several of the levels appear to be rotational states in the unified nuclear model. Yb^{169} decays with a half-life of 30.6 days be K capture, followed by eleven gamma-rays in Tm^{169}. Rotational levels lie at 8.4, 118.3 and 139.1 keV. The gamma energies are 8.4, 20.6 63.2, 93.6, 109.9, 118.3, 130.7, 177.7, 198.6, 261.0 and 308.3 keV. Yb^{175} decays with a half-life of 4.2 days by beta emission (471 keV max) followed by five gamma-rays in Lu^{175}. Rotational levels exist at 114.1 and 251.9 keV. The gamma energies are 114.1, 137.8, 145.0, 282.9 and 397.0 keV. Yb^{177} decays with a half-life of 1.88 hr by beta emission followed by gamma transitions in Lu^{177}. In addition to any lower energy gamma-rays, two high-energy transitions are found at 1.080 and 1.228 MeV. The latter is a cross over for the 1.080 and 0.148 MeV gammas which are in coincidence. The expected well-known daughter product Lu^{177}, if present at all, is too weak to be observed by the magnetic spectrometers. A.

539.163.1

1510. ON THE QUESTION OF THE DECAY OF Ta^{180}. P.Eberhardt, J.Geiss, C.Lang, W.Herr and E.Merz.
Z. Naturforsch., Vol. 10a, No. 9-10, 796 (1955). In German.

The W/Ta and W^{180}/W ratios of tantalite samples from S.Africa were compared with those of normal W; the half-life of the disintegration of Ta^{180} to W^{180} by electron emission was found to be greater than 10^{12} yr. A.O.Stanesby

539.163.1

1511. ON THE DIPOLE SELECTION RULE IN ^{16}O. G.Morpurgo and L.A.Radicati.
Nuovo Cimento (Ser. 10), Vol. 2, No. 2, 360-1 (Aug., 1955).

The half-lives of two (6.13 and 7.1 MeV) dipole transitions in O^{16} have been calculated theoretically, using the shell model with LS (and JJ) coupling, and compared with the experimental results of Devons, et al., (Abstr. 2110/1955). It appears that the violation of the dipole selection rule can be interpreted in terms of Coulomb impurity, and that no information is yielded about the magnitude of the mesonic effect (Abstr. 8911/1954). A.O.Stanesby

539.163.1

1512. SYSTEMATICS OF SPONTANEOUS FISSION HALF-LIVES. W.J.Swiatecki.
Phys. Rev., Vol. 100, No. 3, 937-8 (Nov. 1, 1955).

A close correlation is found between the deviations of the half-lives from a smooth dependence on Z^2/A and the deviations of the nuclear masses from Green's liquid-drop mass surface (Abstr. 10420/1954). An empirical formula for the half-lives results. W.J.Swiatecki

539.163.1

1513. DECAY RATES OF C^{14}, N^{14*} AND O^{14}. R.Sherr, J.B.Gerhart, H.Horie and W.F.Hornyak.
Phys. Rev., Vol. 100, No. 3, 945-6 (Nov. 1, 1955).

Results of measurements on the decay of O^{14} to the ground state of N^{14}, and on the lifetime (less than 3.5×10^{-13} sec) of the magnetic dipole gamma-transition from the analogue state in N^{14*} at 2.31 MeV support the explanation of the very long lifetime of the C^{14} beta-decay being due to chance cancellation

in the matrix element for the decay. A.O.Stanesby

539.163.2

1514. ON THE DECAY SCHEME OF I^{128}. T.Stribel.
Z. Naturforsch., Vol. 10a, No. 9-10, 797 (1955). In German.

Beta-gamma coincidence measurements on the spectra of I^{128} confirm the decay scheme of Siegbahn and Hole (Abstr. 3196/1946) by shewing a partial beta-spectrum (E_{max} about 1.6 MeV) in coincidence with the 428 keV gamma-ray.
A.O.Stanesby

539.163.2

1515. ON THE β-DECAY OF RUBIDIUM 87; A CHECK ON THE DECAY SCHEME AND A NEW DETERMINATION OF THE HALF LIFE. I.Geese-Bähnisch.
Z. Phys., Vol. 142, No. 5, 565-84 (1955). In German.

Measurements on natural rubidium in a double counter gave no coincidences. Hence no converted γ-rays exist and since no unconverted γ-rays have been found, Rb^{87} must decay directly to the ground state of Sr^{87}. After correcting for absorption in the source and backing, measurements of the specific activity gave a value for the half life of 4.3 (+0.3, −0.2) x 10^{10} years. J.Hughes

539.163.2

1516. INVESTIGATIONS OF I^{128}. N.Benczer, B.Farrelly, L.Koerts and C.S.Wu.
Phys. Rev., Vol. 101, No. 3, 1027-30 (Feb. 1, 1956).

The β^-, gamma and electron capture processes of I^{128} were investigated with the solenoidal magnetic spectrometer, a single-channel scintillation spectrometer, a multiple-channel selective coincidence scintillation spectrometer, and a proportional counter spectrometer. Three β^- groups with energies 2.120, 1.665 and 1.125 MeV and relative abundance 76.0 : 15.5 : 2.0, and four gamma radiations with energies 0.455, 0.540, 0.750 and 0.990 MeV and relative intensities 100 : 9.7 : 1.7 : 1.8 were found. The electron capture branch was determined to be 6.4% of the total disintegration. The ratio of electron capture to the ground to that to the first excited state of Te^{128} is 19 : 1. Spin and parity were assigned to the ground and excited states of the daughter nuclei Te^{128} and Xe^{128}, and a decay scheme is proposed for I^{128}. A.

539.163.2

1517. THE DISINTEGRATION OF Cu^{59} AND THE STABILITY OF THE X_Z^{2Z+1} NUCLEI. T.Yuasa, M.E.Nahmias and M.Vivargent.
J. Phys. Radium, Vol. 16, No. 8-9, 654-8 (Aug.-Sept., 1955). In French.

Copper 59 prepared by 5.3 MeV deuteron bombardment of Ni^{58} was identified by its 83.5 ± 1.0 sec half-life and shows a simple β^+ spectrum (E max = 1.85 ± 0.05 MeV). A value of 58.956 02 ± 0.000 30 a.m.u. for the mass of Cu^{59} is deduced. Also present is a weak (not more than 2%) gamma-ray of 1.75 MeV. Regularities in the stability of the X_Z^{2Z+1} nuclei are discussed. M.A.Grace

539.163.2

1518. RADIOACTIVE DISINTEGRATION OF ^{232}Th.
S.W.Peat and M.A.S.Ross.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 923-5 (Oct., 1955).

The energy spectrum of conversion electrons associated with single alpha-particles of range less than 25 μ was determined from impregnated emulsions. Two groups were found with mean ranges 11.25 ± 0.25 and 17.5 ± 0.4 μ corresponding to energies of 42.0 ± 0.5 and 54.5 ± 0.7 keV respectively. Attributing the groups to L and M + N conversion the energy of the transition was found to be 59 ± 1 keV, a value consistent with the difference in the ranges of the alpha-particles with and without associated conversion electrons. The absolute intensity of the conversion electrons was 24 ± 3% and the ratio of L conversion intensity to M + N conversion intensity about 3. J.Hughes

539.163.2

1519. A CONTRIBUTION TO THE STUDY OF THE DISINTEGRATION SCHEME OF Ir_{77}^{192}. F.Grard, L.Danguy and J.Franeau.
J. Phys. Radium, Vol. 16, No. 11, 839-43 (Nov., 1955). In French.

A β-spectrometer of the Siegbahn–Svartholm type was used to measure the energies of the internal and external conversion electrons due to the complex γ-ray spectrum following the decay of Ir^{192}. Assignments to the residual nuclei Pt^{192} and Os^{192} are made and decay schemes suggested.
M.A.Grace

539.163.2

1520. ON THE POSSIBILITY OF DISINTEGRATION BY K-CAPTURE IN Cu^{59}. T.Yuasa and G.A.Renard.
J. Phys. Radium, Vol. 16, No. 11, 889-90 (Nov., 1955). In French.

Nickel K X-radiation accompanying the decay of the β^+ emitter Cu^{59} was identified using a proportional counter. This is attributed to K-capture whose relative intensity (K/β^+) of 5% is in approximate agreement with theory.
M.A.Grace

539.163.2

1521. A NOTE ON EVIDENCE FOR A 2.158 MeV LEVEL IN Ni^{60}. J.L.Wolfson.
Canad. J. Phys., Vol. 33, No. 12, 886-8 (Dec., 1955).

A weak photoelectron line ($1.2 \pm 0.2 \times 10^{-5}$ per disintegration) attributed to a gamma-ray of 2.158 ± 0.005 MeV excited during the decay of Co^{60} was found using a beta-spectrometer. Its origin is discussed. M.A.Grace

539.163.2

1522. RADIOACTIVITY OF Sc^{44}. J.W.Blue and E.Bleuler.
Phys. Rev., Vol. 100, No. 5, 1324-9 (Dec.1,1955).

The decay of Sc^{44} has been reinvestigated using a NaI gamma-ray spectrometer and a magnetic-lens spectrometer adapted to coincidence measurements. The main transition from the Sc^{44} ground state is to the first excited level of Ca^{44} at 1.159 ± 0.003 MeV. The probability for positron emission is 0.932 ± 0.015, in agreement with the theoretical value of 0.928 for an allowed transition (E_{max} = 1.471 ± 0.005 MeV). The conversion coefficients of the 1.16 MeV gamma-ray and of the isomeric transition in Sc^{44} are $6.3 \pm 0.3 \times 10^{-5}$ and 0.139 ± 0.003, compatible with E2 and E4 transitions, respectively. A weak allowed decay leads to a level in Ca^{44} at 2.54 ± 0.03 MeV. The continuous spectrum of low-energy electrons previously reported by J.A.Bruner was found to depend strongly on the thickness of the source and the backing. For the thinnest sources the intensity was ⅓ of that previously reported. Coincidence measurements showed that more than ¾ of the electrons are not coincident with both the positrons and the gamma-rays and are, therefore, not emitted in the process of positron decay. It is concluded that there is no indication for a disagreement between the experiment and the theory of atomic excitation during beta decay. A.

539.163.2

1523. RADIOACTIVE DECAYS OF Rh^{106} AND Ag^{106}. D.E.Alburger and B.J.Toppel.
Phys. Rev., Vol. 100, No. 5, 1357-63 (Dec. 1, 1955).

Transitions in Pd^{106} occurring in the decays of Rh^{106} and Ag^{106} have been examined with a three-crystal pair spectrometer using grey-wedge pulse-height analysis, single and coincidence scintillation spectrometer techniques and an intermediate-image beta-ray spectrometer. In addition to lines previously known, gamma-rays of 1.77, 1.96, 2.10 and 2.66 MeV and a possible gamma-ray of 1.14 MeV are found in Rh^{106} decay. Gamma-rays of energies 0.22, 0.409, 0.51, 0.62, 0.72, 0.805, 1.045, 1.131, 1.205, 1.23, 1.39, 1.55, 1.77, 1.85, 2.1 and 2.63 MeV are observed in Ag^{106} decay. Most of the data can be satisfied by postulating in addition to the five pre-

viously known states in Pd^{106} three new weakly excited levels at 1.85, 2.27 and 2.66 MeV. A lower limit of about 10^{-8} sec is estimated for the partial half-life of the 0-0 transition between the second excited and ground states of Pd^{106}. A.

539.163.2

1524. DECAY OF Ir^{192}. L.L.Baggerly, P.Marmier, F.Boehm and J.W.M.DuMond.
Phys. Rev., Vol. 100, No. 5, 1364-7 (Dec. 1, 1955).

A study has been made of the gamma-radiation following the decay of Ir^{192}. The energies, intensities, internal conversion coefficients and multipolarities of the gamma transitions have been determined. Energy level schemes for the daughter nuclei, Pt^{192}, and Os^{192}, are proposed. The spins and parities of most of the levels are given. A.

539.163.2

1525. DECAY SCHEME OF In^{107}. W.A.Cassatt, Jr and W.W.Meinke.
Phys. Rev., Vol. 100, No. 5, 1372-3 (Dec. 1, 1955).

The gamma radiations of In^{107} were investigated with a scintillation spectrometer. The In^{107} was produced in a cyclotron by a (d, n) reaction on electromagnetically enriched Cd^{106}. Beta-gamma and gamma-gamma coincidence experiments showed, in addition to the annihilation radiation, only one gamma-ray of 0.22 MeV associated with the 2 MeV positron. A.

539.163.2

1526. RADIOACTIVE DECAY OF THE ISOMERS OF AMERICIUM-242. R.W.Hoff, H.Jaffe, T.O.Passell, F.S.Stephens, E.K.Hulet and S.G.Thompson.
Phys. Rev., Vol. 100, No. 5, 1403-6 (Dec. 1, 1955).

The decay characteristics of the two isomers of Am^{242} have been investigated. The beta decay of the 16 hr Am^{242m} has a branching ratio of $51 \pm 5\%$ to the first excited state (42.3 keV) of Cm^{242} with the remainder of the decay going to the ground state. The electron capture decay of Am^{242m} has a branching ratio of approximately 60% to first-excited state (44.8 keV) of Pu^{242}. An upper limit of 6% has been set for the fraction of Am^{242m} decay via isomeric transition. The beta decay of the 100 yr Am^{242} has a branching ratio of $45 \pm 5\%$ to the first-excited state of Cm^{242}, with the remainder of the decay going to the ground state. The beta-spectrum end points for Am^{242m} and Am^{242} have been measured to be 620 ± 10 keV and 585 ± 10 keV, respectively. A decay scheme for the two isomers has been proposed. Log ft values have been calculated for beta and electron capture decay of the isomers and are discussed in conjunction with spin and parity assignments. A.

539.163.2

1527. DECAY SCHEME OF Sc^{47}. R.T.Nichols and E.N.Jensen.
Phys. Rev., Vol. 100, No. 5, 1407-9 (Dec. 1, 1955).

The radiations of Sc^{47} were examined with a scintillation spectrometer and with an intermediate image spectrometer operated in conjunction with a scintillation spectrometer for coincidence spectra. Two beta groups were observed with maximum energy values of 0.596 ± 0.010 MeV and 0.430 ± 0.005 MeV and relative intensities of 36% and 64%, respectively. The log ft values of the beta groups were found to be 6.0 and 5.3, respectively. One gamma-ray was observed having an energy of 0.167 ± 0.002 MeV. The coincidence beta spectrum contained only the lower energy group. The decay scheme for Sc^{47} is discussed. A.

539.163.2

1528. NUCLEAR LEVELS AND TRANSITIONS IN Lu^{175} ACCORDING TO THE UNIFIED MODEL. D.M.Chase and L.Wilets.
Phys. Rev., Vol. 101, No. 3, 1038-40 (Feb. 1, 1956).

The scheme for the decay of Yb^{175} and Hf^{175} is analysed theoretically on the basis of the Bohr–Mottelson strong-coupling unified model. A set of spins and parities for all the levels involved is found to be uniquely consistent with the available experimental data and the level-structure predictions of the model. The anomalously large ratio of M2 to E1 radiation observed in two of the gamma transitions is accounted for as a consequence of configuration forbiddenness. Parallel remarks are made concerning the spectrum of Hf^{177}. A.

539.165

1529. BETA DECAY OF Ne^{23}. H.J.Gerber, M.Garcia Muñoz and D.Maeder.
Phys. Rev., Vol. 101, No. 2, 774-5 (Jan. 15, 1956).

The disintegration of Ne^{23} was formerly considered to contribute to the few examples of superallowed transitions in negative beta decay. This decay was reinvestigated, using scintillation techniques for measuring beta and gamma rays. No gamma ray of the order of 3 MeV is found; however, a gamma ray of 440 ± 5 keV occurs in $36 \pm 4\%$ of the beta decays. For both transitions, to the ground state as well as to the 440 keV level of Na^{23}, log ft is about 5.2. Upper limits for the intensity of higher-energy gamma rays show that log ft is equal to or greater than 5.0 for possible transitions to other levels in Na^{23}. A.

539.165.08 : 537.533.35

HIGH RESOLUTION AUTOMATIC BETA SPECTROMETER. See Abstr. 406.

539.165.2

1530. MATRIX ELEMENTS OF β -DECAY FOR A SPHEROIDAL CORE MODEL. M.Nomoto.
Progr. theor. Phys., Vol. 13, No. 1, 117-19 (Jan., 1955).

Allowance is made for the rotation of a core of constant deformation in the calculation of the matrix elements.
P.T.Matthews

539.165.2 : 539.152.1

1531. NEW TYPE OF SELECTION RULES IN β DECAY OF STRONGLY DEFORMED NUCLEI. G.Alaga.
Phys. Rev., Vol. 100, No. 1, 432-3 (Oct. 1, 1955).

The selection rules are discussed for the case of very large spheroidal deformations, when there is an approximate separation of the motion into oscillations along the symmetry axis and oscillations in the plane perpendicular to this axis. Application is made to the region where A is between 150 and 190. L.Pincherle

539.166

1532. ON THE γ-RADIATION OF TELLURIUM-129. T.Stribel.
Z. Naturforsch., Vol. 10a, No. 9-10, 797-8 (1955). In German.

The spectrum was examined using a scintillation spectrometer, giving a strong line at 460 ± 10 and a weaker (intensity about 1/10) line at 1070 ± 20 keV. A.O.Stanesby

539.166

1533. ROTATIONAL STATES IN Tm^{169} S.A.E.Johansson.
Phys. Rev., Vol. 100, No. 3, 835-40 (Nov. 1, 1955).

The decay of Yb^{169} has been investigated by means of a coincidence scintillation spectrometer. Eleven gamma-rays have been arranged in a level scheme with levels at 10, 120, 142, 318, 336, 382 and 476 keV. The multipolarity of the strongest gamma-rays has been determined and spin values assigned to some of the levels. It is found that five of the levels form a rotational band with $K = 1/2$. In this case the Bohr–Mottelson unified model predicts an anomalous rotational spectrum. The experimental spectrum agrees very well with the theory. The gamma-ray intensities are discussed and there is a good agreement with the unified model also in this respect. A.

539.166

1534. ELECTRIC-MONOPOLE TRANSITIONS IN ATOMIC NUCLEI. E.L.Church and J.Weneser.
Phys. Rev., Vol. 100, No. 3, 943-4 (Nov. 1, 1955).

In many cases E0 internal conversion may compete favourably with M1 and E2 radiative transitions. The monopole matrix elements may be useful in the study of nuclear structure. G.E.Brown

539.166

1535. RADIOACTIVE Ca^{47}. W.S.Lyon and T.H.Handley.
Phys. Rev., Vol. 100, No. 5, 1280-3 (Dec. 1, 1955).

Ca^{47} (4.5 day) has been investigated by using beta-gamma coincidence measurements and NaI gamma-ray spectrometry. Three gamma-rays of energies 1.29, 0.812 and 0.500 MeV are present with absolute intensities of $(71 \pm 6)\%$, $(5 \pm 0.5)\%$ and $(5 \pm 0.5)\%$, respectively. These gammas are in coincidence with a 0.70 ± 0.02 MeV beta group. In addition, $(24 \pm 6)\%$ of the decay is through a 1.9 ± 0.2 MeV beta group directly to the ground state. A.

539.166

1536. NEUTRON-CAPTURE GAMMA-RAY SPECTRA OF V, Co, Ti, Fe, Cr, Au, Mn, and I. M.Reier and M.H.Shamos.
Phys. Rev., Vol. 100, No. 5, 1302-8 (Dec. 1, 1955).

An experiment was performed on the neutron-capture gamma spectra of eight elements in the region of about 100 keV to 2.5 MeV using NaI crystals. Wherever possible, the data are compared with the results of previous experiments and existing energy level schemes. A.

539.166

1537. RADIATIONS FROM FOUR RADIOACTIVE ISOTOPES OF PLATINUM. V.R.Potnis, C.E.Mandeville and J.S.Burlew.
Phys. Rev., Vol. 101, No. 2, 753-8 (Jan. 15, 1956).

The gamma radiations of the 18 hr Pt^{197} have been examined with scintillation counting methods and have been found to consist of 77 and 191 keV quanta in coincidence and a 279 keV gamma-ray which is noncoincident with other gamma-rays. Beta-gamma coincidence studies have been performed and values of log ft have been obtained for the three beta-ray spectra of Pt^{197}. The radiations of Pt^{195m} include gamma-rays of energies 31, 99 and 130 keV. The latter gamma-ray is not to be confused with the highly converted one emitted in the 3.8 day isomeric transition and is the cross-over of the 31 keV - 99 keV cascade. Pt^{193m} emits a gamma-ray of energy 130 keV. No quantum radiations of higher energies were detectable. Some coincidence measurements have been performed on the complex gamma-ray spectrum of Pt^{191}. A.

539.166 : 539.172.13

1538. GAMMA RAYS FROM THE DEUTERON BOMBARDMENT OF BORON 10. J.T.Sample, G.C.Neilson, G.B.Chadwick and J.B.Warren.
Canad. J. Phys., Vol. 33, No. 12, 828-40 (Dec., 1955).

Bombardment of B^{10} with 1.4 MeV deuterons has been found to produce gamma rays of energy $4.46 \pm .04$, $4.75 \pm .03$, $5.03 \pm .09$, $5.35 \pm .05$, $6.52 \pm .04$, $6.78 \pm .07$, $7.29 \pm .04$, $8.27 \pm .09$ and $8.87 \pm .02$ MeV, as measured with a three-crystal pair spectrometer. Tentative assignments to transitions in B^{11} and C^{11} agree well in most cases with the known energy-level schemes. No gamma rays of very high energy were observed, even with a single-crystal spectrometer; consequently an upper limit of 10^{-31} cm^2 has been placed on the cross-section of $B^{10}(d,\gamma)C^{12}$ at 0.95 MeV bombarding energy. A.

539.166 : 539.172.4

1539. GAMMA RAYS FROM INELASTIC NEUTRON SCATTERING. J.J.van Loef.
Utrecht University Dissertation (1955) 83 pp.

Neutrons with energies up to 2 MeV were obtained from the $Li^7(p,n)Be^7$ reaction. The neutron fluxes were measured absolutely with a standard "long counter". The gamma-rays were detected by a NaI crystal calibrated by means of standard gamma-ray sources. Two geometries of scattering were tried. The first used a ring of material to scatter neutrons into an axially located and shielded NaI crystal, and the second used a neutron beam collimated by extensive shielding, a disk scatterer, and a NaI crystal to one side of the neutron beam. Signal/noise ratios were about the same in both arrangements, but the second one gave the best conditions for absolute cross-section measurements. The $Fe^{56}(n,n'\gamma)Fe^{56*}$ reaction up to 1.8 MeV neutron energy showed a single level at 850 keV, deduced to be 2+ by considering the angular distribution and excitation function. The $Mn^{55}(n,n'\gamma)Mn^{55*}$ reaction gave two gamma-rays of energies 128 and 840 keV. These were shown to be in cascade, and a $\frac{5}{2}$ – assignment for the 128 keV level fitted the excitation curve. Nine gamma-rays from iodine were found, and a level scheme is proposed. Three gamma-rays from fluorine were found, two of them in cascade. No levels were observed in phosphorus or strontium, and previously known levels were seen in nickel and tantalum. The data are generally best fitted theoretically by an optical model with an imaginary potential of 8 MeV, compared with the 2 MeV usually used to fit total cross-section. The discrepancy may arise through the assumption that nuclei have sharp edges. J.M.Cassels

539.166.08

1540. A PRECISION CURVED CRYSTAL GAMMA-RAY SPECTROMETER. N.Ryde and B.Andersson.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1117-31 (Dec., 1955).

A curved-crystal spectrometer of transmission type with a radius of curvature of one metre has been constructed, utilizing the (310) planes of quartz. The effective part of the crystal plate has the dimensions 10 mm x 20 mm x 1 mm and subtends 0:00020 steradian at the focus. In order to ensure a high degree of stability the spectrometer is mounted on a strong U-beam. The spectrum is scanned by moving a slit in front of the radiative source along the Rowland circle, the direction of the diffracted beam being fixed in space. The γ-rays are detected by means of a NaI(Tl) scintillation crystal combined with a single-channel pulse height discriminator. The wavelengths and energies of gamma rays from Au^{198}, As^{76}, Sb^{122}, Yb^{175}, Lu^{177}, Re^{186}, Re^{188}, Ir^{192} and Ir^{194}, obtained by pile activation have been measured. A.

539.166.74

1541. SCATTERING OF 30 TO 95 MeV PHOTONS BY PROTONS. C.L.Oxley and V.L.Telegdi.
Phys. Rev., Vol. 100, No. 1, 435-6 (Oct. 1, 1955).

Using 98 MeV bremsstrahlung incident on a liquid hydrogen target, the differential cross-section for elastic scattering has been measured at angles of 50^0 to 150^0, at a mean photon energy of about 64 MeV. The results are consistent with point proton theory to within the experimental errors ($\pm 15\%$ or greater). Calculations show that interference between Thompson scattering and scattering from the proton's meson cloud decreases the cross-section by about 15% at 64 MeV. J.J.Wilkins

539.166.75

1542. A DIRECT MEASUREMENT OF THE ENERGY LOCALLY ABSORBED FROM A GAMMA-RAY BEAM. H.E.Johns, J.P.Bernier and D.W.Cormack.
Nature (London), Vol. 176, 560 (Sept. 17, 1955).

The method used is a calorimetric one with thermistors as the temperature measuring elements. Temperature differences of 10^{-3} deg C can be measured with an accuracy of better than 1%. The absorbers are cylinders of C or Al, and subsequently replacing them by air-filled chambers of the same material enables comparative ionization measurements to be made. The results give W = 33.2 eV/ion-pair. L.E.Mussell

539.166.8

1543. THE HARDNESS OF THE SECONDARY RADIATION FROM Co^{60} γ -RADIATION. I.Y.Krause.
Z. Phys., Vol. 141, No. 4, 411-15 (1955). In German.

Pb-absorption curves of the secondary radiation produced in Al and Pb by Co^{60} γ -radiation were measured and are compared with theory. A.O.Stanesby

539.166.83

1544. INTERNAL CONVERSION ELECTRONS FROM ELECTRIC EXCITATION OF Ta^{181}, Au^{197} AND Pt^{195}. E.M.Bernstein and H.W.Lewis.
Phys. Rev., Vol. 100, No. 5, 1345-50 (Dec. 1, 1955).

Conversion electrons from the electric excitation of Ta^{181}, Au^{197} and Pt^{195} were studied with a magnetic spectrometer. From K/L ratios, multipolarities have been assigned to the following transitions; Ta 137 keV, 0.93 M1 + 0.07 E2; Au 279 keV, 0.75 M1 + 0.25 E2; Pt 210 keV, M1. Direct excitation of the 77 keV level in Au was observed with a reduced transition probability for excitation of $(0.18 \pm 0.06) \times 10^{-48}$ cm^4 e^2. Measured excitation functions indicate levels in Pt at 29 and 126 keV, instead of at 97 and 126 keV, as assigned from radioactive decay studies. Apparent single particle transitions in Au and Pt have E2 transition probabilities an order of magnitude larger than single-particle estimates. A.

539.166.83

1545. CONVERSION ELECTRON SPECTRA OF Cm^{242} AND Cm^{244}. W.G.Smith and J.M.Hollander.
Phys. Rev., Vol. 101, No. 2, 744-50 (Jan. 15, 1956).

The conversion electron spectra have been studied by means of two 180° photographic recording beta-ray spectrographs. Conversion coefficient ratios in the L and M subshells have been measured for several E2 transitions in the decay of these nuclides, and the values so obtained compared with theoretical ratios. Accurate energy determinations of the first three excited states in Pu^{238} are reported, and the validity of the Bohr–Mottelson rotational energy formula, including the vibration-rotation interaction term to describe these states, is discussed. A more accurate value is reported for the energy of the first excited state in Pu^{240}. The decay of I^{131} is discussed briefly. A.

539.166.83

1546. INTERNAL CONVERSION COEFFICIENTS OF Ba^{134}, V^{51} AND Tl^{203}. Z.O'Friel and A.H.Weber.
Phys. Rev., Vol. 101, No. 3, 1076-8 (Feb. 1, 1956).

The internal conversion coefficients of Ba^{134} (parent Cs^{134}), V^{51} (parent, Cr^{51}) and Tl^{203} (parent, Hg^{203}) have been measured by the determination of the gamma-ray yields from the Compton electron spectra produced in an external converter, employing the analysis of R.G.Thomas and T.Lauritsen and a single magnetic lens beta-ray spectrometer. The Ba^{134} results involve the extension of the method to several gamma-ray conversions measured simultaneously. V^{51} represents the application of the method to K-capture type of decay for which the direct area-under-curves method cannot be used. Tl^{203} requires the correction of the measured conversion spectrum for photoelectric conversions to obtain the pure Compton events. The values obtained for the total internal conversion coefficients are Ba^{134}: 569 keV gamma-ray, $(9.2 \pm 1.2) \times 10^{-3}$; 605 keV gamma-ray, $(5.3 \pm 0.5) \times 10^{-3}$; 796 keV gamma-ray, $(2.4 \pm 0.3) \times 10^{-3}$; 1.367 MeV gamma-ray, $(0.49 \pm 0.05) \times 10^{-3}$; V^{51}: 325 keV gamma-ray, $(1.5 \pm 0.2) \times 10^{-3}$; Tl^{203}: 279 keV gamma-ray, for K-shell $(1.5 \pm 0.1) \times 10^{-1}$, and $(4.9 \pm 0.2) \times 10^{-2}$ for the L-shell. In all cases the precision is the standard deviation. The results are in satisfactory agreement with other experimental values and with the predictions of Rose's tables. A.

539.166.832

1547. INTERNAL COMPTON EFFECT. A.M.Yakobson.
Zh. eksper. teor. Fiz., Vol. 29, No. 5(11), 703-5 (1955). In Russian.

Results of an extensive calculation in the non-relativistic approximation are reported here. A simple relation between this effect and internal conversion is given. G.E.Brown

539.166.835

1548. MEASUREMENT OF LOW-ENERGY GAMMA-RAY PAIR CROSS SECTIONS IN SCINTILLATORS USING A SCINTILLATION PAIR SPECTROMETER. H.I.West, Jr.
Phys. Rev., Vol. 101, No. 3, 915-21 (Feb. 1, 1956).

Using a three-crystal pair spectrometer with pulse-height selection on the side crystals, absolute and relative gamma-ray pair production cross-sections were measured in anthracene and sodium iodide, respectively, by making the centre crystal of the spectrometer out of these substances. The experimental data were reduced to yield the following pair cross-sections (gamma-ray energies in MeV given in brackets):

carbon, $\sigma(1.17) = (1.16 \pm 0.05) \times 10^{-28}$ cm^2
$\sigma(1.33) = (6.03 \pm 0.18) \times 10^{-28}$ cm^2

iodine, $\sigma(1.17) = (1.36 \pm 0.05) \times 10^{-26}$ cm^2
$\sigma(1.33) = (6.81 \pm 0.17) \times 10^{-26}$ cm^2
$\sigma(2.76)/\sigma(1.38) = 15.0 \pm 0.8$.

These results are compared with those of other experimenters and with theoretical calculations. A.

NUCLEAR REACTIONS 539.17

539.172

1549. CROSS SECTIONS AND THE COMPLEX POTENTIAL. C.E.Porter.
Phys. Rev., Vol. 100, No. 3, 935-6 (Nov. 1, 1955).

A simple expression is obtained relating the ratio of the reaction cross-section to the elastic cross-section to the imaginary part of the nuclear potential. The result is particularly suitable for numerical calculation. J.Hughes

539.172

1550. NUCLEAR FISSION ON THE BASIS OF THE COLLECTIVE MODEL. I. K. Woeste.
Z. Phys., Vol. 141, No. 5, 643-58 (1955). In German.

The influence of the shell structure on nuclear fission is investigated for a combined single particle and collective model. It is found that the probability of fission is considerably affected by the closure of a shell. Particular attention is paid to the behaviour of the deformation energy near a closed shell. J.Hughes

539.172

1551. NUCLEAR FISSION ON THE BASIS OF THE COLLECTIVE MODEL. II. K.Woeste.
Z. Phys., Vol. 143, No. 1, 31-43 (1955). In German.

Further aspects of the fission process are discussed, using the same model as in Pt I. The low threshold for fission in the neighbourhood of U is attributed to a resonance effect involving the nuclear surface deformation for $l = 2$. The peak observed in the experimentally determined fission cross-section is interpreted as evidence for this resonance. The constants of this surface deformation deduced from both photon and neutron induced fission are not inconsistent. J.Hughes

539.172

1552. RADIOCHEMICAL STUDIES OF THE HIGH-ENERGY FISSION PROCESS. H.G.Hicks and R.S.Gilbert.
Phys. Rev., Vol. 100, No. 5, 1286-93 (Dec. 1, 1955).

Formation cross-sections of a number of fission products of U^{238} have been measured as a function of bombarding particle

energy using deuterons (19-190 MeV), protons (70-340 MeV), and helium ions (50-380 MeV). Fission product distribution curves as well as fission cross-sections have been measured for deuterons and protons of the above energies. The mechanism of high-energy fission is discussed. A.

539.172

1553. ENERGY SPECTRUM OF NEUTRONS FROM SPONTANEOUS FISSION OF CALIFORNIUM-252. E.Hjalmar, H.Slätis and S.G.Thompson.
Phys. Rev., Vol. 100, No. 5, 1542-3 (Dec. 1, 1955).

The spectrum, of evaporation type, was measured by means of proton recoils in photographic emulsion.

J.M.Cassels

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172 : 539.172.3

1554. ELECTRO- AND PHOTODISINTEGRATION CROSS SECTIONS OF Cu^{63}. M.B.Scott, A.O.Hanson and D.W.Kerst.
Phys. Rev., Vol. 100, No. 1, 209-14 (Oct. 1, 1955).

Highly monoergic electrons from a 22 MeV betatron have been used to study the Cu^{62} activity in a pair of 2 mil copper foils separated by a 10 mil copper radiator. The ratio of the photodisintegration to electro-disintegration in the foils decreases by less than 10% in the region from 14 to 20 MeV. The measured value of F at 20 MeV is 8.6 in reasonable agreement with the extrapolation of previous measurements at higher energies and with the value of 8.38 expected on the basis of simple virtual photon calculations. Analysis of the excitation curves gave a $Cu^{63}(\gamma, n)$ cross-section of 80 x 10^{-27} cm^2 which is 20% below most previous measurements. A.

539.172.1

1555. EXCITATION FUNCTION FOR THE REACTION $Be^9(N^{14}, \alpha n)F^{18}$. H.L.Reynolds and A.Zucker.
Phys. Rev., Vol. 100, No. 1, 226-7 (Oct. 1, 1955).

The cross-section for the production of F^{18} by nitrogen bombardment of beryllium was measured as a function of energy. The cross-section varies from 100 to 200 millibarns at energies from 15 to 30 MeV. Below the barrier, the cross-section falls of with decreasing energy in a manner which indicates a barrier penetration by the entire nucleus. A.

539.172.11

1556. ON THE O^{18} (α, n) Ne^{21} REACTION. R.R.Roy, A.Lagasse, M.L.Goes and R.Moerman.
C.R. Acad. Sci. (Paris), Vol. 241, No. 22, 1567-8 (Nov. 28, 1955). In French.

Alpha-particles from a 50 mC Po^{210} source were used to bombard a thick target of water enriched in O^{18} and the relative yields of neutrons for α-particle bombarding energies between 2 and 5 MeV were studied by moderating the neutrons in paraffin and detecting in a BF_3 counter.

M.A.Grace

539.172.11 : 539.172.13

1557. REACTIONS $Be^9(\alpha, \alpha')$, $Be^9(\alpha, d)$ and $Be^9(d, d')$. V.K.Rasmussen, D.W.Miller, M.B.Sampson and U.C.Gupta.
Phys. Rev., Vol. 100, No. 3, 851-5 (Nov. 1, 1955).

The existence of a level in Be^9 at 3.01 ± 0.1 MeV has been verified by the inelastic scattering of 21.6 MeV alpha-particles and 10.8 MeV deuterons. Some evidence has also been found for a level in Be^9 at 1.74 ± 0.1 MeV. However, it is shown that the present experimental data are most simply explained by a three-body break-up of the compound nucleus with a final-state potential-scattering interaction between the outgoing neutron and Be^8. The previously-reported occurrence of the reaction $Be^9(\alpha, d)B^{11}$ to the ground state and 2.14 MeV excited state of B^{11} is verified. A.

539.172.13

1558. INELASTIC POLARIZATION AND NUCLEON MOMENTUM DISTRIBUTION. L.Marshall.
Phys. Rev., Vol. 99, No. 3, 1033-5 (Aug. 1, 1955).

The polarizations produced in pseudo p—p collisions inside a complex nucleus are estimated from free p—p scatterin data, the internal momenta of the struck protons being taken into account. Experimental results are quite well fitted.

J.M.Cassels

539.172.1

1559. ALPHA-ALPHA ANGULAR CORRELATIONS IN $B^{11}(p, \alpha\alpha)He^4$. E.H.Geer, E.B.Nelson and E.A.Wolicki.
Phys. Rev., Vol. 100, No. 1, 215-22 (Oct. 1, 1955).

The angular correlation has been measured between the alpha-particle emitted from C^{12} and one of the break-up alpha particles from Be^8. The measurement was made in a plane at 90 degrees to the proton beam with bombarding energies of 163 and 290 keV. Thin targets of natural boron were used, and the alpha-particles detected with thin scintillation counters. The theoretical correlation functions in the laboratory system were obtained by a numerical integration of the centre-of-mass angular correlation functions over the 2.9 MeV level in Be^8. The probability for decay of the C^{12} state was assumed to have the same energy dependence for different angular momenta of the emitted alpha-particle. Th energy variation was obtained from the energy spectrum of th alpha-particles. Using the two lowest values of angular momentum for the first alpha-particle, the 163 keV data were found to be consistent with a 2+ state in C^{12}, and 2+ but not 0+ or 4+ in Be^8. The data at 290 keV are not consistent with a pure state of spin 1– or 2– or 3+ in C^{12}. They are in agreement with a pure state of 2+ or with a superposition of states at this energy. A

539.172.1

1560. ENERGY DISTRIBUTION OF K MESONS PRODUCED IN NUCLEI. M.M.Block, E.M.Harth and R.M.Sternheimer.
Phys. Rev., Vol. 100, No. 1, 324-7 (Oct. 1, 1955).

K-mesons produced by internal target bombardment at th Brookhaven Cosmotron and Berkeley Bevatron are assumed t be made by the reaction: p + N→Y + N + K, where N = nucleo Y = hypéron. The expected energy distribution of the K-particles is calculated for several laboratory angles at proton bombarding energies of 2.9 BeV and 4.8 BeV, assuming various angular and energy distributions of the K-mesons in the centre-of-mass system of the incoming proton and target nucleon. The internal motions of the target nucleons were take into account by using both the Gaussian and the Fermi momen tum distributions. A

539.172.1

1561. COULOMB EXCITATION DIRECTIONAL CORRELATION. M.Goldstein, J.L.McHale, R.M.Thaler and L.C.Biedenharn.
Phys. Rev., Vol. 100, No. 1, 436-7 (Oct. 1, 1955).

The Coulomb excitation gamma-correlation for Cd^{114} is calculated using the formalism and mathematical techniques previously described (Abstr. 554/1956). A graph is given of the correlation coefficients as a function of proton energy. After an approximate thick target correction has been made to the calculated coefficients, good agreement was found between theory and experiment. J.Hughe

539.172.13

1562. ELECTRIC EXCITATION OF CERTAIN RARE-EARTH NUCLEI BY PROTONS. H.Mark and G.T.Paulissen.
Phys. Rev., Vol. 100, No. 3, 813-22 (Nov. 1, 1955).

Sixteen energy levels have been observed in thirteen isotopes of samarium, europium, gadolinium and terbium. Electric quadrupole transition probabilities have been determined for some of these energy levels from the measured electric excitation cross-sections. For the even-A isotopes

of Gd, the properties of the low-lying energy levels are in good agreement with the expectations of the "strong coupling" rotational model. The first energy levels in the even isotopes of samarium show the sharp break in the position of the first excited level which has been pointed out by Scharff–Goldhaber. In general, the results are in good qualitative agreement with the predictions of the collective model; however, the moments of inertia for the rotational levels observed in this region are substantially larger than those expected from the intrinsic deformations obtained from the radiative transition probabilities. A.

539.172.13

1563. SURVEY OF (p, n) REACTIONS AT 12 MeV. H.G.Blosser and T.H.Handley.
Phys. Rev., Vol. 100, No. 5, 1340-4 (Dec. 1, 1955).

Results of measurements of twenty (p, n) cross-sections on elements from atomic number 21 to 58 are given. The data indicate total reaction cross-sections which, when interpreted in terms of a totally black square well potential of depth 20 MeV, correspond to a potential radius of 1.55 to $1.65A^{1/3}$ x 10^{-13} cm. A.

539.172.13

1564. INELASTIC PROTON SCATTERING FROM VANADIUM. W.W.Buechner, C.M.Braams and A.Sperduto,
Phys. Rev., Vol. 100, No. 5, 1387-90 (Dec. 1, 1955).

The low-lying excited states of V^{51} have been investigated by means of inelastic proton scattering. Protons were accelerated to 6.0, 7.0 and 7.4 MeV in the MIT-ONR electrostatic generator, and the scattered protons were analysed with a broad-range magnetic spectrograph, observations being made at 90 and 130 degrees to the incident beam. Proton groups were found which corresponded with levels in V^{51} at 0.322 ± 0.002, 0.931 ± 0.003, 1.614 ± 0.005 and 1.819 ± 0.05 MeV. A large number of lower energy groups were observed, which are associated with excited states between 1.85 and 4.50 MeV. Two groups of alpha-particles were also observed and assigned to the ground state and first excited state formed in the $V^{51}(p,\alpha)Ti^{48}$ reaction (Q = 1.161 and 0.167 MeV). A.

539.172.13

1565. INELASTIC SCATTERING OF 19-MeV PROTONS BY O^{16}. W.F.Hornyak and R.Sherr.
Phys. Rev., Vol. 100, No. 5, 1409-14 (Dec. 1, 1955).

The NaI scintillation spectroscopy of the proton groups from the inelastic scattering of 19 MeV protons by O^{16} yielded levels in O^{16} at 6.14, 7.02, 8.87, 9.85, 10.34, 11.08, 11.51 12.02, 12.53, 13.06 and possibly 13.39 MeV, with an error of ± 30 keV. The levels at 8.87 and 11.08 MeV are probably 2^- in character and are found to decay by gamma-rays cascading through the states at 6 and 7 MeV. The relatively weakly excited level at 12.02 MeV is probably accompanied by gamma-ray emission. Differential cross-sections for most inelastic groups are also given. A.

539.172.13

1566. SPALLATION OF VANADIUM WITH 60-, 100-, 175-, AND 240-MeV PROTONS. C.G.Heininger and E.O.Wiig.
Phys. Rev., Vol. 101, No. 3, 1074-6 (Feb. 1, 1956).

Cross-sections have been determined for most of the observable radioactive nuclides produced in the bombardment of vanadium with 60, 100, 175, and 240 MeV protons. The pattern of yields supports the cascade-evaporation theory. The number of nuclides produced in high yield is found to increase with increasing bombarding energy. A.

539.172.13

1567. ASYMMETRIES OF THE RANGES OF FRAGMENTS IN THE FISSION OF HEAVY NUCLEI BY VERY FAST PARTICLES. V.P.Shamov and O.V.Lozhkin.
Zh. eksper. teor. Fiz., Vol. 29, No. 3(9), 286-91 (1955). In Russian.

Nuclear emulsions previously soaked in uranium, bismuth and tungsten solutions, are irradiated with a beam of 660 MeV protons. The fission is often accompanied by a number of charged particles; a mean angle between fragments corresponds to a definite number of charged particles and hence the energy of excitation of the original nucleus can be determined. Strongly asymmetrical fissions increase with increasing energy and this increase is greater for Bi than for U. For excitation energies of 400 MeV or over, the character of fission is the same for U, Bi and W. G.E.Brown

539.172.13

1568. PROTON-INDUCED FISSION CROSS SECTIONS FOR U^{238}, U^{235}, Th^{232}, Bi^{209}, AND Au^{197} AT 100 TO 340 MeV. H.M.Steiner and J.A.Jungerman.
Phys. Rev., Vol. 101, No. 2, 807-13 (Jan. 15, 1956).

A cancellation-type ionization chamber was used to detect the fission fragments. The observed fission cross-sections are compared to the total inelastic cross-sections in order to obtain the relative fission probability as a function of proton energy. A.

539.172.13

1569. NOTE ON COULOMB EFFECTS IN STRIPPING REACTIONS. J.Sawicki.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 3, No. 6, 313-19 (1955).

For deuteron stripping where the neutron is captured into the S-state in the approximation of zero-range n–p interaction and for an independent particle model of the nucleus, Coulomb effects may be included analytically. Effects are also considered for the $Li^6(n,\alpha)H^3$ reaction. G.E.Brown

539.172.13

1570. MATHEMATICAL ANALYSIS OF A SIMPLE MODEL FOR THE STRIPPING REACTION. R.Jost.
Z. angew. Math. Phys., Vol. 6, No. 4, 316-26 (1955).

An integral equation arising from a very much simplified model of the stripping reaction is discussed. The Wiener–Hopf method can be employed. The resulting equations can be reduced to difference equations, which can, in principle, be solved. The explicit solution for a special case is given. G.E.Brown

539.172.13

1571. d, p REACTIONS FROM C^{12} AND C^{13}. J.N.McGruer, E.K.Warburton and R.S.Bender.
Phys. Rev., Vol. 100, No. 1, 235-9 (Oct. 1, 1955).

Observations have been made of the proton groups resulting from the deuteron bombardment of a carbon target enriched to 60% in C^{13}. A total of twenty-four such groups was observed, of which eleven have been assigned to levels in C^{13} and thirteen to levels in C^{14}. The experimental angular distributions are compared with the predictions of stripping theory. The excitation values for twelve previously unreported levels have been obtained with probable errors of ±0.02 MeV. These levels are at 7.47, 9.50 and 9.90 MeV in C^{13} and at 6.59, 7.35, 8.32, 9.80, 10.43, 10.50, 12.60, 12.85 and 12.96 MeV in C^{14}. A.

539.172.13

1572. ABSOLUTE CROSS SECTIONS FOR DEUTERONS ON BERYLLIUM. R.E.Heft and W.F.Libby.
Phys. Rev., Vol. 100, No. 3, 799-813 (Nov. 1, 1955).

The absolute cross-section for the reactions of deuterons on beryllium which produce tritium and Be^{10} have been measured up to energies of 17 to 20 MeV. Data of Dejong, Endt and Simons show no threshold which is as expected for exothermic (d, p) and (d, t) processes. For the reaction producing Be^{10}, which is equivalent to the introduction of a neutron into the beryllium nucleus by the bombarding deuteron, the cross-section rises to a peak value of about 0.34 barn, at about 4 MeV. It then falls almost linearly to the low value of 0.08 barn at 20 MeV. There are evidences of fine structure

in the curve but it is possible that these are not really significant. The reaction producing tritium rises to a peak value of about 0.23 barn at about 5 MeV and then falls to a low value of about 0.03 barn at 13 MeV. The reaction cross-section appears to remain essentially constant at this low value although it may rise slightly as the energy is raised to about 20 MeV. A new reaction producing tritium begins at 17.47 MeV, namely one which produces both tritium and Be^7 simultaneously. This corresponds to the ejection of both a triton and a neutron as a result of the deuteron Be^9 collision. This cross-section rises from zero at the threshold linearly to a value of 8×10^{-5} barn at 21.5 MeV. A.

539.172.13

1573. NEUTRONS PRODUCED IN THE BOMBARDMENT OF BERYLLIUM BY DEUTERONS. F.Boreli and B.Lalovic.
Nature (London), Vol. 176, 1021 (Nov. 26, 1955).

The thin-target yield of neutrons from the $Be^9(d, n)B^{10}$ reaction emitted at approximately 90^0 to the beam was studied for deuteron energies between 0.7 and 1.5 MeV. The yield curve indicates a resonance at 1 MeV. M.A.Grace

539.172.13

1574. FISSION PRODUCT YIELDS OF URANIUM BOMBARDED WITH DEUTERONS OF VARIOUS ENERGIES (20-190 MeV). H.G.Hicks, P.C.Stevenson, R.S.Gilbert and W.H.Hutchin.
Phys. Rev., Vol. 100, No. 5, 1284-6 (Dec. 1, 1955).

The formation cross-sections of Sr^{89}, Zr^{97}, Pd^{109}, Pd^{112}, Ag^{111} and Ba^{140} were measured from the bombardment of natural uranium with deuterons of various energies (20-190 MeV). A.

539.172.13

1575. ENERGY LEVELS OF S^{33}, S^{35}, Cl^{36}, Cl^{38} AND Ba^{139}. C.H.Paris, W.W.Buechner and P.M.Endt.
Phys. Rev., Vol. 100, No. 5, 1317-23 (Dec. 1, 1955).

Barium chloride targets were bombarded with deuterons accelerated by an electrostatic generator to energies between 3.0 and 7.5 MeV. Charged reaction products were observed with a high-resolution magnetic analyser. The following ground-state Q-values were measured: $Cl^{35}(d,\alpha)S^{33}$, 8.277 ± 0.010 MeV; $Cl^{37}(d,\alpha)S^{35}$, 7.783 ± 0.012 MeV; $Cl^{35}(d, p)Cl^{36}$, 6.354 ± 0.008 MeV; and $Cl^{37}(d, p)Cl^{38}$, 3.881 ± 0.008 MeV. Fifteen levels were observed in S^{33}, four in S^{35}, twenty-three in Cl^{36}, and six in Cl^{38}. From the intensities of the observed proton groups and other considerations, a spin of $J = 2^-$ can be assigned to the Cl^{38} ground state, and a spin of $J = 5^-$ to the lowest (isomeric) level in Cl^{38} at 672 ± 5 keV. The $Ba^{138}(d, p)Ba^{139}$ ground-state Q-value is 2.493 ± 0.010 MeV, and a level in Ba^{139} is observed at 623 ± 8 keV. A.

539.172.13

1576. ON THE NEUTRONS FROM THE $N^{14}(d, n)O^{15}$ REACTION. I.Nonaka, S.Morita, N.Kawai, T.Ishimatsu, S.Suematsu, K.Takeshita, Y.Nakajima and Y.Wakuda.
J. Phys. Soc. Japan, Vol. 11, No. 1, 1-7 (Jan., 1956).

The energy spectrum and the angular distribution of the neutrons from the $N^{14}(d, n)O^{15}$ reaction were investigated by the photographic plate method. The energy of the bombarding deuterons was 1.85 MeV, and the Q-value corresponding to the ground state of the O^{15} nucleus was found to be (5.21 ± 0.07) MeV. The low-energy neutron group corresponding to the first excited state of the O^{15} nucleus was also observed, but it overlapped with the contaminated $C^{12}(d, n)N^{13}$ neutrons and the accurate Q-value could not be determined. The estimated rough value was about −0.1 MeV. The angular distribution of the high-energy neutron group has a maximum at about 20 degrees (c.m.s.) and decreases considerably beyond this maximum, indicating a stripping process corresponding to $l_p = 1$. This reaction may be a good source of neutrons of about 7 MeV at the bombarding energies of deuterons below 2 MeV. A.

539.172.13

1577. ANGULAR DISTRIBUTION OF THE PROTONS FROM THE $O^{16}(d, p)O^{17}$ REACTION AS A FUNCTION OF THE BOMBARDING ENERGY. J.C.Grosskreutz.
Phys. Rev., Vol. 101, No. 2, 706-9 (Jan. 15, 1956).

The angular distribution of the protons form the reaction $O^{16}(d, p)O^{17}$ leaving O^{17} in its ground and first excited states has been measured as a function of the deuteron bombarding energy. Deuterons of energy 2.51, 2.26, 2.01, 1.76, 1.60, 1.35 and 1.05 MeV were used to bombard thin ZnO targets. The resulting protons were detected at angles ranging from 5 to 160 degrees with respect to the deuteron beam. Detection was accomplished with CsI(Tl) phosphors on photomultipliers mounted as a unit in the vacuum housing of the reaction chamber. The characteristic forward stripping maxima are obtained in both reactions plus considerable yield in the backward direction, especially near resonances in the reaction. The effect of a resonance at 1.7 MeV is to flatten the distribution curves so as almost completely to mask their stripping character. Secondary maxima observed in the excited state distributions are interpreted as the result of nuclear interaction of the stripped proton with the residual nucleus. Coulomb effects are also observed as the deuteron energy is lowered. The stripping maxima are shifted to larger angles and the valleys become less pronounced. Absolute differential cross-sections for the reactions are also given. A.

539.172.3

1578. ELECTRONS EMITTED FROM METALS AFTER THE IRRADIATION BY 1.5 MeV X-RAYS. J.J.Orlin.
Univ. Bergen Arbok, (1954, publ. 1955) No. 9, 14 pp.

After irradiation of metals by 1.5 MeV X-rays the emission of electrons was found to be due to the "after-effect" due to the charging of an insulating surface oxide film, except for Ag and Cd which also gave the well known conversion electrons due to their isomeric states. No conversion electrons due to isomeric states with half-lives between 20 sec and 15 min could be found for the following metals: Mg, Al, Fe, Ni, Cu, Zn, Mo, Pd, Sn, Ta, W, Au and Pb. A.

539.172.3

1579. NEUTRON–PROTON POTENTIAL AND PHOTODISINTEGRATION OF THE DEUTERON. K.Chadan.
J. Phys. Radium, Vol. 16, No. 11, 843-8 (Nov., 1955). In French.

It is shown how the slope, near threshold, of the cross-section curve for photodisintegration of the deuteron may be used, in conjunction with other data, to determine uniquely the neutron–proton potential. Only central forces are considered. A particular example is worked out numerically to illustrate the general method. J.J.Wilkins

539.172.3

1580. ENERGY AND ANGULAR DISTRIBUTIONS OF PHOTONEUTRONS PRODUCED BY 70-MeV X-RAYS. W.R.Dixon.
Canad. J. Phys., Vol. 33, No. 12, 785-96 (Dec., 1955).

The angular distributions of the photoneutrons produced by 70 MeV X-rays in seven elements have been measured with a zinc sulphide–lucite scintillation detector. For the heavy elements the distributions are essentially isotropic, indicating the predominance of the evaporation process, while for the light elements there is also an anisotropic component peaked at 90^0. The energy distributions of the photoneutrons produced in copper and lead targets have been determined with nuclear emulsions. It is shown that most of the neutrons can be attributed to an evaporation process which is governed by a constant nuclear temperature, the temperature found for copper being 1.2 MeV, and for lead being 1.0 MeV. A high-energy tail on the energy distributions is attributed to direct interactions. A

539.172.3

1581. PHOTODISINTEGRATION OF C^{12} AND O^{16}.

F.I.Havliček and B.Dobovišek.
Phys. Rev., Vol. 100, No. 5, 1355-7 (Dec. 1, 1955).

Measurements were carried out on the distribution in energy and angle of the alpha-particles from 485 C^{12} and 57 O^{16} disintegrations induced by bremsstrahlung of 27 and 33 MeV maximum energy. These measurements yield information on the energy levels in Be^8, C^{12} and O^{16}. A.

539.172.3

1582. DETAILED STUDY OF THE $O^{16}(\gamma, n)\,O^{15}$ REACTION. A.S.Penfold and B.M.Spicer.
Phys. Rev., Vol. 100, No. 5, 1377-86 (Dec. 1, 1955).

The yield curve for this reaction has been examined in detail over most of the energy region between 15.6 MeV and 23.2 MeV. Fine structure in the form of sudden changes of slope, or "breaks" had been previously reported by the Saskatchewan group. The existence of these breaks was confirmed, and a number of new breaks have been found. The yield curve was analysed for cross-section in the vicinity of a break at 16.03 MeV, and it was found that the cross-section has a resonance shape with a width of 18 ± 5 keV. The yield curve breaks are interpreted as manifestations of narrow resonances in the cross-section. Integrated cross-sections, peak heights, and radiative widths were estimated for all the levels found. On the basis of the radiative widths, it is concluded that, below about 19 MeV the reaction proceeds by absorption of E2 radiation, while between 22 and 23 MeV it proceeds principally by absorption of E1 radiation. No conclusion could be drawn for the 20 to 21 MeV region. From a consideration of the total integrated cross-section, and the cross-section at 17.63 MeV it is concluded that the bulk of the gamma-ray absorption by O^{16} takes place into narrow levels. A.

539.172.3

1583. YIELD OF PHOTONEUTRONS FROM U^{235} FISSION PRODUCTS IN BERYLLIUM AND DEUTERIUM. S.Bernstein, W.K.Ergen, F.L.Talbott, J.K.Leslie and C.P.Stanford.
J. appl. Phys., Vol. 27, No. 1, 18-22 (Jan., 1956).

The yield of photoneutrons from a sample of U^{235} fission products at the centre of a 9 in. dia. Be sphere was measured. Samples of U^{235} were exposed to neutrons in the reactor for periods of 15 min, 6 hr, and 74 hr. The photoneutrons created by the fission product gamma-rays acting upon the Be nuclei were observed from 0.3 sec to about 4 weeks after the end of the exposure. Curves showing the photoneutron yield as a function of time, relative to the delayed neutron yield, are given for these exposure and observation times. The attempt was made to account for the observed yields from Be in this experiment, and the yield from D_2O observed in an earlier experiment, in terms of known fission product gamma emitters. A.

539.172.3

1584. INTEGRATED PHOTONUCLEAR CROSS SECTION. J.S.Levinger.
Phys. Rev., Vol. 101, No. 2, 733 (Jan. 15, 1956).

Re-examines a step in the Levinger–Bethe calculation of the nuclear exchange force contribution to the summed dipole oscillator strength. The reduction of a triple sum to the double sum used by Levinger and Bethe can be justified if complete symmetry between neutrons and protons is assumed. A.

539.172.3

1585. DELAYED NEUTRONS, ACCOMPANYING THE PHOTODISINTEGRATION OF URANIUM AND THORIUM. L.E.Lazareva, B.S.Ratner and I.V.Shtranikh.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 274-9 (1955). In Russian.

Activity v. time is measured and relates to the isotopes U^{238} and Th^{232} principally. Specimens in paraffin blocks are irradiated with γ-rays of maximum energy 18.5 MeV. Neutrons are registered in a BF_3 ionization chamber. The percentages of neutrons which were delayed were 0.41 ± 0.02% for uranium and 0.18 ± 0.01% for thorium. This is a report on work carried out in 1950. G.E.Brown

539.172.3

1586. AVERAGE NUMBER OF NEUTRONS IN A SINGLE ACT OF FISSION IN PHOTODISINTEGRATION OF URANIUM AND THORIUM. B.N.Valuev, B.I.Gavrilov, G.N.Zatsepina and L.E.Lazareva.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 280-5 (1955). In Russian.

Uranium and thorium are irradiated by bremsstrahlung of maximum energy 18.6 MeV (mean energy of excitation of the nucleus about 12 MeV). To define the number ν of neutrons, the absolute yield of photoneutrons and fragments is measured. The photoneutrons are slowed down by paraffin and then registered in a BF_3 ionization chamber. The number of fragments is measured by an ionization chamber near to the specimen. For uranium, $\nu = 6.2 \pm 0.5$; for thorium, 14.2 ± 1.2. This is a report on work carried out in 1951-2. G.E.Brown

539.172.3 : 539.152.1

1587. THE PHOTONUCLEAR EFFECT AND THE COMPLEX POTENTIAL-WELL NUCLEAR MODEL. J.P.Davidson.
Nature (London), Vol. 176, 649-50 (Oct. 1, 1955).

Calculations of total photonuclear cross-section have been made, assuming absorption of the photon by a single nucleon, which then escapes from, or is absorbed by, the nucleus. The calculations were based on a complex, square-well model, assuming various forms for the imaginary part of the potential. Numerical results are reported for antimony (A = 125), showing poor agreement with experiment. In particular, the predicted integrated cross-sections are too low by a factor of about 10. J.J.Wilkins

539.172.3 : 537.533

1588. USE OF A BETATRON IN NUCLEAR PHYSICS. G.Boulégue.
J. Phys. Radium, Vol. 16, No. 11, 874-82 (Nov., 1955). In French.

A brief review of the techniques involved in the measurement and interpretation of excitation curves for photonuclear reactions. The main topics treated are calibration of betatron energy and intensity, determination of the photon spectrum, and derivation of photonuclear cross-section curves. 34 refs. J.J.Wilkins

539.172.4

1589. TOTAL CROSS SECTION OF THE NUCLEUS OF SEVERAL ELEMENTS FOR NEUTRONS OF ENERGY 590 MeV. V.P.Dzhelepov, V.I.Satarov and B.M.Golovin.
Zh. eksper. teor. Fiz., Vol. 29, No. 3(9), 369-71 (1955). In Russian.

Total cross-sections for elements including H and D are obtained for neutrons of mean effective energy 590 MeV produced by bombarding beryllium with 680 MeV protons. G.E.Brown

539.172.4

1590. ESTIMATION OF THE RANGE OF THE RECOIL ATOMS P^{32} AND S^{35} EMITTED BY THE REACTIONS (n, α) AND (n, p) ON CHLORINE. P.Süe.
J. Phys. Radium, Vol. 16, No. 8-9, 734-5 (Aug.-Sept., 1955). In French.

Thin layers of a mixture of NaCl crystals and anthracene were irradiated with pile neutrons. After irradiation the distribution of activity between the anthracene and the NaCl enabled an estimate of the range to be made. The mean ranges in NaCl were 0.5 ± 0.2 and 0.05 ± 0.03 microns for P^{32} and S^{35} respectively. J.Hughes

539.172.4

1591. THE ENERGY DISTRIBUTION OF PROTONS FROM THE REACTION Cu(n,p)Ni AT 14 MeV. D.L.Allan.
Proc. Phys. Soc. A, Vol. 68, Pt 10, 925-7 (Oct., 1955).

The energy spectrum of protons emitted in the forward direction from thin foils of medium weight elements bombarded by 14 MeV D-T neutrons was measured by the nuclear emulsion method. Although there was some indication of high energy particles, the most significant feature is that 85% of the protons are below the barrier energy (7.2 MeV). The interpretation is rendered difficult by the possible presence of deuterons. J.Hughes

539.172.4

1592. 14-MeV (n,α) CROSS-SECTION MEASUREMENTS. H.G.Blosser, C.D.Goodman, T.H.Handley and M.L.Randolph.
Phys. Rev., Vol. 100, No. 1, 429-30 (Oct. 1, 1955).

Values obtained were: Zn^{68}, 7.6 ± 0.8; Zr^{90}, 3.3 ± 0.6; Zr^{94}, 3.6 ± 0.5; and In^{115}, 2.5 ± 0.4 mb, using a comparison technique in which the cross-section for the 14 MeV (n,p) reaction on Fe^{56} was taken as 110 mb. These values differ radically from the trend reported by Paul and Clarke (Abstr. 2723/1953) in a previous survey of (n,α) reactions, and are in order-of-magnitude agreement with predictions of the statistical theory of nuclear reactions. A.O.Stanesby

539.172.4

1593. SPIN DEPENDENCE OF THE S-WAVE NEUTRON INTERACTION WITH Li^7. R.G.Thomas, M.Walt, R.B.Walton and R.C.Allen.
Phys. Rev., Vol. 101, No. 2, 759-64 (Jan. 15, 1956).

The angular distributions of the neutrons scattered elastically by Li^7 have been measured at four energies in the vicinity of the p-wave resonance at 256 keV. Pronounced departures from symmetry are observed, the scattering being predominantly forward below resonance and backward above resonance. These departures are analysed for information on the nature of the s-wave "background" interaction. By taking into account the known values of the coherent and incoherent scattering cross-sections at zero energy, it is possible to conclude that the parallel-spin ($J = 2^-$) s-wave interaction is the stronger. Several other examples are cited from the literature on light nuclei which also indicate a stronger parallel-spin s-wave interaction, the magnitudes of the splittings being of the order of 1 MeV. A.

539.172.4

1594. ACTIVATION CROSS SECTIONS OF Y^{90} AND Pr^{142}. R.R.Smith and S.D.Reeder.
J. chem. Phys., Vol. 23, No. 11, 2108-10 (Nov., 1955).

The irradiation of Y^{89} and Pr^{141} under a sufficiently high thermal neutron flux produces small amounts of Y^{91} and P^{143} by secondary neutron capture. A measurement of the second-order activities, completely unobservable at the end of the irradiation, may be made after the shorter lived first-order activities have disappeared. From relative measurements of the first- and second-order activities induced in Y^{89} and Pr^{141}, values for the activation cross-sections of Y^{90} and Pr^{142} have been established. For Pr^{142} a value of $\sigma_{act} = 18 \pm 3$ barn was found; for Y^{90} a value of 6.5 barn was established as an effective upper limit. A.

539.172.4

1595. THE ACTIVATION PERTURBATION OF INDIUM FOILS IN NEUTRON DISTRIBUTIONS. H.Meister.
Z. Naturforsch., Vol. 10a, No. 9-10, 669-80 (1955). In German.

Measurements were made of the corrections which have to be made to the measured activation due to the absorption of the foil perturbing the neutron distribution in the medium. The corrections were measured as a function of the foil radius and thickness for a circular disk, for both paraffin and graphite. The experimental results are compared with the calculations of various authors. J.Hughes

539.172.4 : 545.82

ERRORS IN NEUTRON ACTIVATION ANALYSIS. See Abstr. 777.

539.172.

1596. A METHOD FOR RAPID ANALYSIS OF NEUTRON RESONANCES. D.J.Hughes.
J. nuclear Energy, Vol. 1, No. 4, 237-43 (June, 1955).

The shapes of neutron absorption curves are distorted by Doppler effect and by the finite resolution of velocity selectors. Ideally, the total width and total cross-section can be found by comparing the areas of absorption "dips" observed for thin and thick samples. Usually it is only practical to use samples of intermediate thickness, when Doppler broadening again becomes a complicating factor. Corrections for this can involve a tedious process of successive approximatio The method proposed in the present paper enables the requisite nuclear information to be obtained from measurement of the dip areas for samples of intermediate thickness by usi a single set of curves. D.R.Chic

539.172.4

1597. SLOW NEUTRON RESONANCES IN RHENIUM. G.Ig
Phys. Rev., Vol. 100, No. 5, 1338-9 (Dec. 1, 1955).

A crystal spectrometer was used to investigate the total cross-section of rhenium for neutrons of energy 1 eV to 13 eV Resonances were deteced at 2.156, 4.416, 5.90, 7.2, 11.1, 11.9 and 12.8 eV. Two resonances were analysed to obtain the parameters of the Breit–Wigner single-level formula. The radiation widths measured in this experiment are in agre ment with the general trend in radiation widths near A = 185. A new resonance was observed at 11.9 eV. A.

539.172.4

1598. RADIATION WIDTHS IN THE SLOW NEUTRON RESONANCES OF HAFNIUM. G.Igo and H.H.Landon.
Phys. Rev., Vol. 101, No. 2, 726 (Jan. 15, 1956).

The parameters of the 1.100 eV and the 2.39 eV resonances in hafnium have been determined from total cross-section measurements using the Brookhaven crystal spectrometer. The methods of analysis used take into account the Doppler broadening and the finite resolution of the instrument. The radiation widths of the 1.100 eV and the 2.39 eV resonances are 0.067 eV and 0.060 eV, respectively. The remaining one level parameters for each resonance are presented. A

539.172.4

1599. NEUTRON ABSORPTION CROSS SECTIONS OF Pa^{231} AND Pa^{232}. R.R.Smith, N.P.Alley, R.H.Lewis and A.VanderDoes.
Phys. Rev., Vol. 101, No. 3, 1053-6 (Feb. 1, 1956).

Activation studies of Pa^{231} in the graphite region of the Materials Testing Reactor have resulted in a value of 200 ± 15 barns for the thermal neutron absorption cross-section of Pa^{231}. Resonance neutron effects were eliminated by the method of cadmium differences and by conducting the irradiations in a region where the ratio of resonance to thermal neutrons is small. Measurements of the Pa^{233} and Pa^{233} activitie produced in a highly intense neutron irradiation of Pa^{231} have resulted in a value of 760 ± 100 barn for the absorption cross-section of Pa^{232}. A

539.172.

1600. SMALL-ANGLE SCATTERING OF NEUTRONS BY INTERMEDIATE AND HEAVY NUCLEI. S.E.Darden, R.B.Perkins and R.B.Walton.
Phys. Rev., Vol. 100, No. 5, 1315-17 (Dec. 1, 1955).

Differential cross-sections for scattering of neutrons at forward angles have been measured at three energies for several elements The results are compared with predictio of the complex square well potential of Feshbach, Porter, ar Weisskopf.

539.172.4

601. ELASTIC SCATTERING OF 80 keV NEUTRONS. .D.Allen and A.T.G.Ferguson.
roc. Phys. Soc. A, Vol. 68, Pt 10, 940-1 (Oct., 1955).

The neutrons produced by the reaction $Li^7(p, n)Be^7$ were cattered by Sr, Sn and U and the angular distributions measred with a proton recoil counter. Both Sr and Sn showed nisotropic scattering, probably ascribable to the p-wave ingle-particle resonance predicted at A = 92, for this energy, y the complex potential model of the nucleus (Abstr. 524/1955). gave an isotropic angular distribution. J.Hughes

539.172.4

602. DIFFERENTIAL ELASTIC SCATTERING OF 14-MeV EUTRONS IN Bi, Ta, In, Fe, AND S. J.O.Elliot.
hys. Rev., Vol. 101, No. 2, 684-8 (Jan. 15, 1956).

The differential elastic scattering cross-sections of Bi, a, In, Fe, and S for 14-MeV neutrons were measured at cattering angles between 5° and 55° with an angular resolution rying from ±1° to ±3° using a cylindrical geometry and a bi-sed scintillation detector with a threshold of 12 MeV. Mul-ple-scattering corrections were made using an approximate eoretical method. The experimental results were compared calculated cross-sections using a phase-shift analysis based n the complex square-well model of the nuclear interaction. A.

539.172.4

603 INELASTIC SCATTERING OF NEUTRONS BY DE-ORMED NUCLEI. D.M.Brink.
roc. Phys. Soc. A, Vol. 68, Pt 11, 994-1000 (Nov., 1955).

The cross-section for direct inelastic scattering from the uclear surface deformation is calculated and compared with e compound nucleus inelastic cross-section. It is found, ing optical model wave functions, that the direct process can important in the regions of atomic weight near A = 150 and = 240. A.

539.172.4

604. PRODUCTION OF Y^{89m}, Ba^{137m} AND Hg^{199m} BY ELASTIC NEUTRON SCATTERING. C.P.Swann and R.Metzger.
ys. Rev., Vol. 100, No. 5, 1329-33 (Dec. 1, 1955).

Isomeric states in Y^{89} (913 keV), Ba^{137} (661 keV) and Hg^{199} (27 keV) have been excited by inelastic scattering of mono-ergetic neutrons. The shape of the excitation curves agrees ther well with the prediction of the strong interaction theory, t the theoretical cross-sections are, at least in the cases th simple decay schemes, considerably larger than the perimental ones. A.

539.172.4

605. FISSION OF HEAVY NUCLEI BY HIGH ENERGY EUTRONS. V.I.Gol'danskiĭ, É.Z.Tarumov and V.S.Pen'kina. okl. Akad. Nauk SSSR, Vol. 101, No. 6, 1027-30 (1955). In ussian. English translation in Atomic Energy Res.Establ. Harwell) Transl. No. 581, 5pp. (1955).

It is assumed that fission by high-energy neutrons takes ace when the excited nucleus, left behind after initial fast ucleon—nucleon collisions, has evaporated sufficient neutrons bring the critical energy for fission below the binding energy the next neutron. The required number of evaporation neu-ons and the fission threshold energy were computed for a mber of nuclides between tungsten and uranium. The cross-ections for fission at 84, 120, and 380 MeV were measured xperimentally and show good correlation with the computed esults. Some information can be inferred about the distribu-on of excitation energies in the nuclei left behind after the st primary collisions. J.M.Cassels

539.172.4

606. SYSTEMATICS OF FISSION ASYMMETRY. .J.Swiatecki.
Phys. Rev., Vol. 100, No. 3, 936-7 (Nov. 1, 1955).

The trend in the separation between the peaks in the fission yield curves for 8 nuclei is found to be consistent with $A(\text{heavy}) - A(\text{light}) = 0.090\,(40.2 \pm 0.7 - Z^2/A)^{1/2}$. The form of this relation is suggested by theory. W.J.Swiatecki

539.172.4

1607. USING BORON-TRIFLUORIDE GAS FOR REACTOR CONTROL. W.E.Cawley.
Nucleonics, Vol. 13, No. 8, 30-3 (Aug., 1955).

A control system based upon the variation of pressure of BF_3 gas, in a tube located in a reactor, is described. The method has been used to control the Hanford 305 graphite—natural U test reactor. L.R.Shepherd

539.172.4

1608. SOME NOTES ON THE THEORY OF THERMAL-NEUTRON REACTORS. J.D.Stewart.
Canad. J. Phys., Vol. 34, No. 1, 20-3 (Jan., 1956).

Equations for the asymptotic steady-state distribution of neutrons in homogeneous and lattice-type reactors are derived without making any assumptions about the mechanism of diffusion, except the obviously necessary one that the probability for a neutron which is born at one given point to be captured at a second given point is a function only of the distance between these two points. The equations are seen to be of a form that admits of exponential solutions, these are written down, and equations for the Laplacians are derived. A clear-cut definition of the migration area of a lattice reactor is given, and it is pointed out that in a reactor of this type there is no unique value of the Laplacian but rather a range of values. A.

539.174

1609. COULOMB EXCITATION OF TELLURIUM AND SILVER. L.W.Fagg, E.A.Wolicki, R.O.Bondelid, K.L.Dunning and S.Snyder.
Phys. Rev., Vol. 100, No. 5, 1299-302 (Dec. 1, 1955).

Coulomb excitation has revealed gamma-rays at 159, 274, 342, 436 and 504 keV in Te^{123}; 435 and 633 keV in Te^{125}; 319 and 419 keV in Ag^{107}; and 306 and 412 keV in Ag^{109}. Interpretation of these results in conjunction with excitation curves and coincidence measurements is discussed in terms of proposed energy level schemes. In the case of Te^{123} it is concluded that three levels are independently excited. Values are given for the quadrupole moments, Q_0, based on the Bohr—Mottelson unified model and for the reduced transition probabilities for excitation, $B_e(E2)$. A.

539.174 : 551.578

1610. ATOM BOMB EXPLOSIONS AND THE pH OF RAIN. H.Harrassowitz.
Naturwissenschaften, Vol. 43, No. 1, 11-12 (1956). In German.

The proposition of Martin (Abstr. 1224/1955) that an H-bomb explosion will produce nitric acid, and so change the pH of rain that plant life will be disrupted, is discussed, and experimental data produced to show that in fact rain is often acid. J.M.Hough

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

1611. OBSERVATIONS OF NEGATIVE K-MESONS AND CHARGED HYPERONS. W.F.Fry, J.Schneps, G.A.Snow and M.S.Swami.
Phys. Rev., Vol. 100, No. 3, 950-2 (Nov. 1, 1955).

207 K^- mesons were observed in stacks exposed to the bevatron. A maximum in the prong distribution of K^- meson

stars was observed at 3. Charged π mesons, charged hyperons, and hyperfragments were observed, and the frequency of the various types of events is given and discussed. It is suggested that the basic capture process for the negative K meson is $K^- + N \rightarrow Y + \pi$. An estimate of the lifetime of Σ hyperons is made, and it is pointed out that results are in agreement with the basic Σ^- capture process as predicted. Observations on K^- mesons and charged hyperons, too, are in agreement with predictions. E.W.Kellermann

539.18

1612. ON THE PROBLEM OF SYSTEMATIZATION OF HEAVY MESONS AND HYPERONS. J.Rayski.
Acta phys. Polon., Vol. 14, No. 1-2, 149-51 (1955).

More details of the author's scheme (Abstr. 9423/1955) in comparison with the known particles. P.T.Matthews

539.18

1613. PHENOMENOLOGICAL TREATMENT OF THE DECAY OF LIGHT HYPERFRAGMENTS. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 2, No. 2, 373-9 (Aug., 1955).

The decay of a bound (Λ^0, p) system into $p + p + \pi^-$ is studied. By separating the probability of the process (written as function of the π^- momentum) into kinematical factors and factors depending on the details of the interaction, it is possible to conclude, without using specific models, that the type of event observed in the preceding abstract would have an appreciable probability of occurrence. Corrections due to final state interactions are found to be small. W.J.Swiatecki

539.18

1614. NOTE ON THE DECAY AND ABSORPTION OF THE θ^0. A.Pais and O.Piccioni.
Phys. Rev., Vol. 100, No. 5, 1487-9 (Dec. 1, 1955).

A suggestion is made on how to verify experimentally a recent theoretical suggestion that the θ^0 meson is a "particle mixture". A.

539.18

1615. ON THE MEASUREMENT OF THE MEAN LIFETIME OF STRANGE PARTICLES. E.Amaldi.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 1, 253-62 (1955).

A review of some of the possible methods of measuring the lifetimes of K- and Y-particles detected by cloud chambers and nuclear emulsions in the cosmic radiation. Applying some of the methods to the known results on charged Y-particles found in emulsions, assuming they are all due to the same particle, a value for τ of between 3×10^{-10} and 0.5×10^{-10} sec is obtained. D.J.Prowse

539.18

1616. MEAN LIFETIME OF POSITIVE K MESONS.
E.L.Iloff, W.W.Chupp, G.Goldhaber, S.Goldhaber, J.E.Lannutti, A.Pevsner and D.Ritson.
Phys. Rev., Vol. 99, No. 5, 1617-18 (Sept. 1, 1955).

K^+-mesons from the bevatron were followed in nuclear emulsion and decays in flight identified, giving a lifetime of $1.01 - 0.21 + 0.33 \times 10^{-8}$ sec. No decay in flight of a τ^+-meson was observed in the distance scanned. G.E.Brown

539.18

1617. IONIZATION AT THE ORIGIN OF ELECTRON PAIRS, AND THE LIFETIME OF THE NEUTRAL PION. D.H.Perkins.
Phil. Mag., Vol. 46, 1146-8 (Oct., 1955).

It was found from measurements on pairs of average energy 180 BeV in nuclear emulsions that the ionization near the origin of the pair was less than that of the two particles separately. From these measurements an estimate was made of the uncertainty the effect would cause in the lifetime of the neutral pion determined from the length of the gap between the centre of the star and the first clearly resolved grain of the electron pair resulting from the decay mode $\pi^0 \rightarrow e^+ + e^- + \gamma$. The error thus introduced is very small compared with the statistical errors in recent measurements. J.Hughes

539.18

1618. LIFETIMES OF THE τ^+- AND K_L^+-MESONS.
G.Harris, J.Orear and S.Taylor.
Phys. Rev., Vol. 100, No. 3, 932 (Nov. 1, 1955).

Lifetime values have been obtained by measuring the attenuation of the bevatron K-meson beam relative to π-mesons and protons of the same momentum over a distance of 70 inches. Two identical emulsion stacks were exposed 70 in. apart. 35 τ-mesons and 77 K_L-mesons were found in the near stack and 17 τ-mesons and 156 K_L-mesons in the far stack. These figures yielded the following lifetimes: $\tau K_L = 7^{+1.5}_{-1} \times 10^{-9}$ and $\tau_\tau = 8^{+5}_{-2} \times 10^{-9}$ sec. The τ/K_L ratios are the same in the two stacks: 20.8 ± 4.5 and 17.5 ± 4.8; there is hence no indication of a difference in lifetime. D.J.Prowse

539.18

1619. ANGULAR CORRELATION EFFECTS IN V-PARTICLE DECAY. S.B.Treiman and H.W.Wyld, Jr.
Phys. Rev., Vol. 100, No. 3, 879-82 (Nov. 1, 1955).

In decay processes of the types: hyperon → nucleon + pion; or K-meson → pion + pion, the most general distribution function in η — the angle between the decay plane normal and a reference direction N normal to the line of flight of the unstable particle — has the form of a finite Fourier series. The degree of the highest harmonic is simply related to the spin of the unstable particle. The coefficients in the series depend on the state of polarization of the spin with respect to the reference direction N. It is possible however to set upper limits on the coefficients; this may prove useful in any attempt to analyse angular correlation data, particularly in the case of hyperon decay. The upper limits for various low spin values are computed, and other consequences of the angular momentum and parity conservation laws are discussed. A.

539.18

1620. ON THE BINDING ENERGIES OF LIGHT HYPERFRAGMENTS. E.Diana and F.Duimio.
Nuovo Cimento (Ser. 10), Vol. 2, 370-2 (Aug., 1955). In Italian.

Reports a variational calculation of the binding energies of $_1H^{4t}$ and $_2He^{4t}$, applying a simple model used previously to describe $_1H^{3t}$ (Abstr. 5224/1955). The $N-\Lambda_0$ and $N-N$ forces are supposed to be of pure Majorana character, and due to interaction with the π_1-meson field ($m_{\pi_1} = 965 m_e$) and the ordinary π-meson field, respectively. In the model these forces are represented by Gaussian potential wells whose depths and ranges, V_0, α_0 and V_1, α_1, respectively, are related by $\alpha_1 = \alpha_0/\beta$, $V_1 = \beta V_0$ where β is the ratio of the meson masses, $\beta = 3.5$. The binding energies obtained are $E(_1H^{4t}) = 16.1$ MeV, $E(_1H^3) = 13.5$ MeV and $E(_2He^{4t}) = 15.2$ MeV. J.M.Radcliffe

539.18

1621. MASS MEASUREMENTS OF PARTICLES AND EXISTENCE OF 1450 m_e MESONS. A.Husain, C.J.D.Jarvis and E.Pickup.
Phys. Rev., Vol. 99, No. 5, 1612-13 (Sept. 1, 1955).

Cosmic-ray measurements in nuclear emulsions give no indication of the mass 1450, but can be explained on the basis that the particles are pions, K-mesons, protons, deuterons and tritons. G.E.Brown

539.18

1622. MASS VALUES OF THE K-MESONS. R.W.Birge, J.R.Peterson, D.H.Stork and M.N.Whitehead.
Phys. Rev., Vol. 100, No. 1, 430-1 (Oct. 1, 1955).

Additional mass values are reported for a large number of K-mesons found in two emulsion stacks exposed to 114 MeV

nd 170 MeV focused K-mesons from the bevatron. For 59 K_L-mesons and 55 τ-mesons in stack 1 the mean values re, 971 ± 1.3 and 978 ± 4 electron masses respectively, and or 177 K_L-mesons and 16 τ-mesons in stack 2, the values re 962.9 ± 1.9 and 965.4 ± 3.8 m_e. D.J.Prowse

539.18

623. SCATTERING OF PIONS BY NUCLEONS IN INTERMEDIATE COUPLING. M.H.Friedman, T.D.Lee and R.Christian.
Phys. Rev., Vol. 100, No. 5, 1494-501 (Dec. 1, 1955).
An intermediate-coupling method of calculation is applied o the meson-nucleon scattering problem for the case of symnetric pseudoscalar mesons, coupled to a fixed extended ource through derivative coupling. It is found that the experinentally observed P-wave phase shifts can be explained by aking the coupling constant $f^2 = 0.712$ and the cutoff $\omega_{max} = .21$ meson masses. (This corresponds to a renormalized oupling constant $f_r^2 = 0.105$.) A.

539.18

624. SPIN OF THE τ^+ MESON. B.T.Feld, A.C.Odian, M.M.Ritson and A.Wattenberg.
Phys. Rev., Vol. 100, No. 5, 1539-40 (Dec. 1, 1955).
A study of the decay of 54 τ^+ –mesons in a large emulsn stack irradiated by the Berkeley Bevatron. Angular disributions and the energy of the π^--meson are observed. G.E.Brown

539.18

625. STRONG PION-PION INTERACTION MODEL APLIED TO PION-NUCLEON SCATTERING IN THE 1-BeV EGION. G.Takeda.
Phys. Rev., Vol. 100, No. 1, 440-1 (Oct. 1, 1955).
The $\pi^{\pm}$, p cross-sections from 0.5 to 1.5 BeV are worked ut in the impulse approximation assuming a T = 1 resonance nteraction with a virtual pion surrounding a non-scattering ore. The effect of the momentum distribution of the virtual ion and inelastic effects are considered. W.J.Swiatecki

539.18

626. CAPTURE OF K^--MESON WITH EMISSION OF HIGHNERGY ELECTRON AS THE ONLY VISIBLE PRONG. .B.Williams, D.M.Haskin, M.Koshiba and M.Schein.
Phys. Rev., Vol. 100, No. 5, 1547-8 (Dec. 1, 1955).
A K^--meson was observed to eject an electron when pparently at rest. The ejected particle is identified as an lectron by the measurement of grain-density (1.11 ± 0.03 x inimum) and multiple scattering (giving a $p\beta$ of 73.7 ± .1 MeV/c). It is suggested that because the K_{3e} mode of ecay is comparatively rare, this event is unlikely to be a $\rightarrow$ e decay from a Bohr orbit inside the nucleus. It is herefore probably an example of an interaction not previously bserved. D.J.Prowse

539.18

627. NUCLEAR INTERACTION IN FLIGHT OF A -HYPERON. W.F.Fry, J.Schneps, G.A.Snow and M.S.Swami.
Phys. Rev., Vol. 100, No. 3, 939 (Nov. 1, 1955).
A particle emerging from a K^--meson star was observed cause a second star after travelling for 1.2 cm. One parcle from this star apparently decayed into a π -meson of 15 ± 20 MeV. The particle is hence assumed to be a -hyperon. The particle from the K^--star was not sufficient- energetic to create a Σ -hyperon in the second star, it is erefore thought to be the Σ -hyperon itself. The event is us interpreted as an inelastic scattering of a Σ -hyperon. total track length of 9.8 cm was observed in the course of llowing 35 hyperon tracks from 207 K^--stars and this was e only interaction found. D.J.Prowse

539.18

1628. A TENTATIVE ANALYSIS OF π -2 π PROCESS. D.Ito and S.Minami.
Progr. theor. Phys., Vol. 13, No. 1, 108-9 (Jan., 1955).
An analysis of two-pion production data for 1.5 BeV mesons incident on nucleons indicates that the two states of isotopic spin are of comparable importance. J.S.Bell

539.18

1629. ON DOUBLE PION PRODUCTION IN NUCLEON-NUCLEON COLLISION. D.Itô.
Progr. theor. Phys., Vol. 13, No. 1, 123-4 (Jan., 1955).
The angular distribution and energy spectrum of pion pairs from scattering of 1.75 BeV neutrons on hydrogen are calculated taking account of final state interactions and using a Tamm–Dancoff method. The results are consistent with the experiments of Abstr. 10529 (1954). W.J.Swiatecki

539.185

1630. THERMAL FLUX DISTRIBUTION FROM A FAST NEUTRON LINE SOURCE. G.W.Stuart.
J. appl. Phys., Vol. 27, No. 1, 89-90 (Jan., 1956).
The spatial distribution of thermal neutrons originating from a fast neutron line source, with slowing down described by age theory, and thermal percolation through an infinite, isotropic medium described by diffusion theory, is presented. A.

539.185

1631. A SIMPLE MEASUREMENT OF THE ABSOLUTE OUTPUT OF NEUTRON SOURCES. P.Jensen, H.P.Terfloth and H.Averdung.
Z. Naturforsch., Vol. 10a, No. 11, 825-31 (1955). In German.
A comparison is made between a source of unknown output and that of a RdTh source, situated at the centre of an Al sphere filled with heavy water, for which the output can be cal culated. Tests on a Ra-Be neutron standard show a discrepancy of 6.7%. A possible reason for this is discussed. J.Thewlis

539.185

1632. NEUTRON YIELDS FROM AMERICIUM–BERYLLIUM ALLOYS. O.J.C.Runnalls and R.R.Boucher.
Nature (London), Vol. 176, 1019-20 (Nov. 26, 1955).
An account is given of the preparation of Am–Be alloys as neutron sources. Yields of 71.7 ± 1.8 and 48.5 ± 1.4 neutrons per 10^6 α-particles are found for Be/Am concentrations of 263 and 14 to 1. M.A.Grace

539.185

1633. SMALL-ANGLE SCATTERING OF FAST POLARIZED NEUTRONS BY HEAVY NUCLEI. J.T.Sample.
Canad. J. Phys., Vol. 34, No. 1, 36-42 (Jan., 1956).
Detailed calculations have been carried out which indicate that the small-angle scattering of fast neutrons by lead depends on the polarization, or spin orientation, of the neutrons. When the scattering of neutrons whose spin vectors point upward is observed in the horizontal plane, more neutrons should be found scattered to the right than to the left. For completely polarized 3.1 MeV neutrons, the theory predicts a maximum "right to left" intensity ratio of 14.5 : 1 at a scattering angle of 0.5°, the ratio decreasing to 1.6 : 1 at 5°, and approaching unity rapidly as the scattering angle increases. A.

539.185

1634. SCATTERING OF POLARIZED NEUTRONS FROM PROTONS AT 350 MeV. R.T.Siegel, A.J.Hartzler and W.A.Love.
Phys. Rev., Vol. 101, No. 2, 838-42 (Jan. 15, 1956).
Asymmetries in neutron–proton scattering have been measured at 350 MeV with a 16% polarized neutron beam. Recoil protons were detected at angles between 10° and 65° in

the laboratory, with asymmetries measured to about ½% accuracy. When compared with the results of p–n scattering with polarized protons, the present experiment gives information on the spin dependence of the scattering matrix. A.

539.185 : 539.152.1

3.4 MeV NEUTRONS SCATTERED BY LEAD AND BISMUTH. See Abstr. 555.

539.185.08

1635. TIME OF FLIGHT SPECTROMETER FOR FAST NEUTRONS. G.C.Neilson and D.B.James.
Rev. sci. Instrum., Vol. 26, No. 11, 1018-24 (Nov., 1955).

A fast neutron spectrometer, using the time-of-flight method, which may also be used to study reactions involving the simultaneous emission of neutrons and gamma-rays, is described. One stilbene scintillation counter is placed close to the source, the other a suitable distance away. The two are connected to a new type of coincidence time sorter which converts delay time between associated events into a pulse amplitude distribution which may be analysed by a kicksorter, so enabling the whole range of delay times or energies to be displayed and recorded at one time. The delay time may result from neutron flight time following scattering in the first counter, from the time of flight of a neutron from the target associated with a gamma-ray entering the first counter, or from a charged particle associated with a gamma-ray. Using $D(d, n)He^3$ neutrons and a flight path of 50 cm, it has been possible to measure the energy with an accuracy of 10%. Angular correlations arising from $(-, n\gamma)$ reactions may be studied with energy discrimination of the neutrons; typical results are presented for the case $Be^9(d, n\gamma)B^{10}$. A.

539.185.08

1636. FAST NEUTRON COINCIDENCE SPECTROMETER.II. P.R.Chagnon, G.E.Owen and L.Madansky.
Rev. sci. Instrum., Vol. 26, No. 12, 1165-70 (Dec., 1955).

For Pt I, see Abstr. 8707 (1953). A fast neutron coincidence spectrometer utilizing stilbene scintillators is described. The principle of the spectrometer is based upon the pulse-height analysis of the recoil protons resulting from a 45 degree scattering of the incident neutron beam. This is achieved by requiring the scattered neutron to be recorded in a secondary ring of ten stilbene scintillators. With delays corresponding to a fixed time of flight, a coincidence between the primary and secondary crystals gates the primary pulse. At 4 MeV the efficiency is of the order of 10^{-4} per incident neutron, and the pulse-height distribution has a width at half-maximum of 17%. The corresponding energy width is 10%. The time-of-flight characteristic is used to reject gamma-rays. Limitations caused by accidentals and pulse-height resolution are discussed. A.

539.185.08

1637. HIGH RESOLUTION CRYSTAL SPECTROMETER FOR NEUTRONS. V.L.Sailor, H.L.Foote, Jr, H.H.Landon and R.E.Wood.
Rev. sci. Instrum., Vol. 27, No. 1. 26-34 (Jan., 1956).

A spectrometer has been developed which has relatively good resolution over an effective energy range from 0.08 to >20 eV. The figure of merit which has been obtained is 0.171 microsec/m with Be(1231) and 0.127 microsec/m with Be (22$\bar{4}$2) monochromator. The good resolution is made possible by a multiple channel collimator (Soller slit) of novel design. The collimator is described in detail and the resolution function for the system is derived and discussed. It is shown that the resolution of the system is essentially independent of the mosaic spread of the crystal. Experimental results are presented which illustrate the performance of the instrument. A.

539.185.7 : 539.172.4

INTERNATIONAL VALUES OF THE EFFECTIVE CROSS-SECTIONS OF FISSILE NUCLIDES FOR THERMAL NEUTRON See Abstr. 681.

STRUCTURE OF SOLIDS 539.2

539.21

1638. FIXATION OF IODINE IN SELENIUM. R.A.Hyman and D.H.Tomlin.
Nature (London), Vol. 176, 977 (Nov. 19, 1955).

Tracer experiments on the selenium–iodine system using iodine-131 support the view that halogen atoms can be bound in the Se structure, probably at the ends of chains of Se atoms. C.A.Hogarth

539.213 : 666

1639. DENSITY ANALYSIS OF GLASS IN TRANSFORMATION RANGE. E.Kanai and T.Satoh.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1002-6 (Nov., 1955).

Analysing the transformation phenomena of glass, the authors emphasize that the fundamental irreversible change is caused by the network deformation. Further, it is noted that the rate equation of the network deformation plays an essential role in the stabilization process of glass and that this equation can be assumed in a simple form with the use of the network temperature which represents the state of network configuration. Next, the equation is applied to the analysis of the density data by Daragan and it is shown that the activation energy of the rate mechanism is dependent upon the network temperature in accordance with the theory and its numerical value is nearly equal to the activation energy of viscosity. A.

539.21

1640. INVESTIGATIONS ON THE MOVEMENT OF MARKERS DURING THE DIFFUSION OF GOLD AND SILVER. W.Seith, T.Heumann and G.Walther.
Naturwissenschaften, Vol. 42, No. 19, 532-3 (Oct., 1955). In German.

The movement of the interphase boundary is proportional to $\sqrt{t}$ only for small times of observation; for longer times the velocity of diffusion decreases due to vacancy formation. In some parts of the specimen the markers were found to have moved in a direction opposite to that of the interphase boundary, the effect being more pronounced on the Ag rich side. The effect shows that Darken's equation is only valid over a part of the diffusion zone. E.P.Wohlfarth

539.217

1641. DIFFUSION OF ZINC IN SINGLE CRYSTALS OF SILVER. A.Sawatzky and F.E.Jaumot, Jr.
Phys. Rev., Vol. 100, No. 6, 1627-9 (Dec. 15, 1955).

The diffusion of Zn in Ag has been measured in the temperature range from 640° C to 925° C, using high-specific-activity Zn^{65} as a tracer. The data indicate that the diffusion coefficient is given to within 2% by the equation,

$$D = 0.54 \exp(-41\,700/RT) \text{ cm}^2/\text{sec}.$$ A.

539.217

1642. EFFECT OF ANTIMONY IMPURITY ON SELF-DIFFUSION OF SILVER. E.Sonder.
Phys. Rev., Vol. 100, No. 6, 1662-6 (Dec. 15, 1955).

Coefficients for diffusion of Ag^{110} into single crystals of alpha silver-antimony were measured as a function of temperature and concentration, over the range 550-900° C and 0-1¼% antimony concentration. In addition, a number of measurements were made of the diffusion of Sb^{124} into similar alloys. The activation energy for silver self-diffusion was found to decrease by 1⅓ kcal per % added antimony. Effects

of impurity were appreciably less for solute diffusion than for solvent diffusion. The results are in qualitative agreement with theories of Overhauser and Lazarus, and indicate that effects due to changes in vacancy concentration are smaller than those resulting from changes in mobility energy. A.

539.217 : 537.311.33

.643. REMOVAL OF COPPER FROM GERMANIUM. K.B.Blodgett.
J. appl. Phys., Vol. 26, No. 12, 1520-1 (Dec., 1955).

N-type Ge crystals were treated with a copper salt and heated at 800° C in hydrogen so as to allow the diffusion of Cu into the crystals. Further treatments were then given at 700° C (a) in a hydrogen atmosphere, (b) in an oxygen atmosphere, or (c) with a coating of an iron salt over the surface, in hydrogen. Tests indicated that all these treatments had caused the removal of Cu from the Ge samples.

C.A.Hogarth

539.217 : 548.5

644. SELECTIVE OXIDATION OF SILVER–MAGNESIUM ALLOYS IN WATER VAPOR. M.Hirashima.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1055-64 (Dec., 1955).

A simple method is described for measuring low rates of selective oxidation of Ag–Mg alloys at elevated temperatures when water vapour is used as oxidizing agent. It is found that the MgO layer builds up on the surface of the alloy according to a parabolic law over a range of the water vapour pressure from 7×10^{-3} to 6×10^{-2} mm Hg, and the oxide growth begins to follow a linear law rather than a parabolic law at a pressure of 1 mm Hg. In the region where the parabolic law holds, the growth of the oxide layer seems to be controlled by the diffusion of Mg through the layer. 20.7 kcal/mol is obtained as the activation energy of diffusion. Applying the transition state theory of gas–metal reaction, as developed by Gulbransen, the diffusion constant of Mg through the oxide layer is given by $D\ (cm^2/sec) = 2.17 \times 10^{-9} \exp(-20\,700/RT)$. A.

539.23

645. PREPARATION OF THIN UNSUPPORTED FILMS. P.Prugne, J.Blandin-Vial, A.Godin, G.Lechauguette and P.Léger.
J. Phys. Radium, Vol. 16, No. 8-9, 730-1 (Aug.-Sept., 1955). In French.

Methods are described by which thin metallic films are produced on substrates, subsequently dissolved. Nickel, unlike the other 15 metals examined, must be evaporated on copper. R.A.Weale

539.232 : 539.42

646. MECHANICAL STRENGTH OF THIN FILMS OF METALS. J.W.Beams, J.B.Breazeale and W.L.Bart.
Phys. Rev., Vol. 100, No. 6, 1657-61 (Dec. 15, 1955).

The tensile strength of silver films was determined as a function of their thickness. The films were electrodeposited on the complete cylindrical surfaces of small steel rotors and the rotor speeds necessary to throw them off were determined. Both the tensile strength and the adhesion of the films were obtained by using rotors of different radii. Also, the adhesion was measured by electrodepositing the films on the rotor in circumferentially disconnected patches which eliminate the loop stresses. In most of the measurements, the adhesion was made vanishingly small by dipping the rotors in an albumin solution before electrodepositing the film and by thermal cycling. The tensile strengths of the films thicker than about 2×10^{-5} cm were found to be independent of thickness and approximately equal to that of bulk silver at the corresponding temperature. For thickness from 6×10^{-5} cm to 2.5×10^{-5} cm the data show some scatter, but below 2.5×10^{-5} cm the tensile strength increases many-fold. The region where the tensile strength increases very rapidly is slightly dependent upon the electrodeposition current but within experimental error is independent of film temperature. A.

539.26

1647. INVESTIGATION OF THE FATIGUE OF METALS BY X-RAY SCATTERING. A.Franks and J.Holden.
Nature (London), Vol. 176, 1022-3 (Nov. 26, 1955).

By the use of a low-angle scattering technique streaks due to regions of changed electron density within a grain have been detected after prolonged cyclic stressing. It is suggested that these regions are disk-like holes on 111 planes.

A.E.De Barr

539.26 : 539.213.1

1648. STRUCTURE IN VITREOUS SILICATES AS SHOWN BY LOW-ANGLE SCATTERING OF X-RAYS. L.C.Hoffman and W.O.Statton.
Nature (London), Vol. 176, 561-2 (Sept. 17, 1955).

Silica when slowly cooled from 1080° C gives central scattering and a discrete diffraction ring: quenched silica gives no ring. $Na_2O.MgO.3SiO_2$ shows the opposite behaviour. A revision of the random-network theory of glass structure seems to be desirable. A.R.Stokes

539.26 : 548.73

1649. SCATTERING BY A SYMMETRIC POTENTIAL. R.J.Finkelstein and M.Moe.
Phys. Rev., Vol. 100, No. 6, 1775-9 (Dec. 15, 1955).

Scattering by a symmetric structure, such as a regular molecule or crystal, is discussed in terms of a variational principle. The appropriate partial waves are labelled by the irreducible representations of the crystallographic groups and may be generated by a set of projection operators, one for each irreducible representation. The trial functions are chosen to lie in a space spanned by the crystallographic partial waves. Methods are indicated for generating either the finite set of partial waves needed for an exact solution or a finite set more useful in an approximate calculation. A.

539.26 : 548.73

1650. STRUCTURE OF SEMI- AND NON-CRYSTALLINE MATERIALS. U.W.Arndt.
Nature (London), Vol. 177, 121-2 (Jan. 21, 1956).

Brief report of a conference held by the X-ray Analysis Group of the Institute of Physics, Nov. 18-19, 1955.

539.27

1651. ELECTRON OPTICAL INVESTIGATIONS ON Se. W.Theis.
Z. Naturforsch., Vol. 10a, No. 6, 503-4 (1955). In German.

Describes the different appearances which Se presents in the electron microscope when obtained as an evaporated layer under various conditions and at various temperatures.

J.Thewlis

539.27

1652. ELECTRON DIFFRACTION ON SUPERCOOLED GOLD. T.Suzuki.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1026-7 (Nov., 1955).

Electron diffraction patterns of gold foil are taken at different temperatures up to and including the melting point. One photograph is believed to correspond to the supercooled state. It shows extra haloes which are stated to resemble those obtained from a polished gold layer. J.Thewlis

539.27 : 539.234

1653. STRUCTURAL CHANGES IN EVAPORATED FILMS OF GERMANIUM IN THE ELECTRON MICROSCOPE. E.W.Fischer and H.Richter.
Ann. Phys. (Leipzig), Vol. 16, No. 5-8, 193-209 (1955). In German.

The effect of temperature rise on amorphous evaporated films of germanium has been studied by making use of the heating effect of the incident electron beam within the electron microscope itself. Various changes in structure were observed, depending on the thermal conditions: transformation from

A

amorphous to crystalline; re-crystallization; twin-formation; crystallization from the vapour phase. To determine the nature of twin formation, combined shadow and diffraction pictures were obtained, as well as normal bright field images. By this means it was shown that in the re-crystallized films twin formation occurred with the (III) plane as twinning plane. To facilitate the work a camera using 35 mm film was built into the electron microscope. V.E.Cosslett

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.31

1654. THE FUNDAMENTAL CONNECTION BETWEEN DISLOCATION DENSITY AND STRESS FUNCTIONS. E.Kröner.
Z. Phys., Vol. 142, No. 4, 463-75 (1955). In German.

In an elastic body containing a distribution of dislocations specified by a tensor density α, the stresses are characterized by a symmetrical tensor, but the strains, ϵ, contain an antisymmetrical component. The compatibility equation of elasticity theory is replaced by a relation between α and the antisymmetric part of ϵ. The formal relations between these quantities and the tensor stress functions are derived. W.M.Lomer

539.31 : 539.374

1655. ON SOME VARIATIONAL PRINCIPLES IN THE THEORY OF ELASTICITY AND THE THEORY OF PLASTICITY. H.-C.Hu.
Scientia Sinica, Vol. 4, No. 1, 33-54 (March, 1955).

The equations of equilibrium, stress–strain relations, strain-displacement relations, and boundary conditions in elasticity theory are all embodied in a single general variational principle in which the components of displacement, strain and stress are treated as 15 independent functions. Similar variational principles are formulated, equivalent to all the equations governing the bending of thin elastic plates, or the equations of plastic deformation, or of plastic flow. Some of the more familiar variational principles are deducible as special cases. J.G.Oldroyd

539.32 : 534.14

1656. MEASUREMENT OF THE ELASTIC CONSTANTS OF SOLIDS BY MEANS OF ULTRASONICS. G.Mayer and J.Gigon.
J. Phys. Radium, Vol. 16, No. 8-9, 704-16 (Aug.-Sept., 1955). In French.

A hot platinum wire vibrates in an electric field fed from an oscillator operating in the megacycle range and thus produces a beam of ultrasound. This beam falls upon an end face of a beam of the material to be studied and sets up longitudinal vibrations. The beam is supported at the two nodes and a microphone placed against the end remote from the source is used to detect when the beam is vibrating in resonance, the frequency of the source being adjusted to give this condition. The modulus of elasticity of the material is computed from the dimensions of the beam and the frequency giving resonance, corrections being applied if necessary when the cross-section of the beam is large compared with its length. Poisson's ratio is computed from the frequency of the fundamental vibration of the beam and that of the second harmonic. The internal damping of the material is also determined from formulae given in the paper. A.C.Whiffin

539.37 : 537.312.62

RIGIDITY MODULUS OF A SUPERCONDUCTOR. See Abstr. 377.

539.373 : 548.574

1657. FORMATION OF ETCH PITS ON SLIP LINES IN ALUMINIUM. G.Wyon and J.M.Marchin.
Phil. Mag., Vol. 46, 1119-22 (Oct., 1955).

It is found that not all slip systems, nor all lines in each system etch in the same way. There is no concentration of etch pits when a slip line ends at a grain boundary. If a slip line crosses a boundary the etch pits stop on one side. Experiments show that diffusion of Mn impurity assists etching. The etch pits occur preferentially on slip systems with a [100] direction normal to the surface. It is concluded that many factors control the formation of etch pits at dislocations. W.M.Lomer

539.374

1660. ON A THEORY OF THE VISCOELASTICITY OF MATERIALS. A.Sentis.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1700-2 (Dec. 14, 1955). In French.

Some simple solutions are considered of the plane longitudinal elastic wave equation in a material of the type considered in the preceding abstract. J.G.Oldroyd

539.374

1658. A GENERALIZED THEORY OF PLASTICITY INVOLVING THE VIRIAL THEOREM. H.Eyring and T.Ree.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 3, 118-22 (March, 1955).

A form of the relationship between rate of shear, shear stress and temperature in plastic flow of a metal is calculated in terms of free energies of activation, by an extension of the theory of rate processes. J.G.Oldroyd

539.374

1659. ON A THEORY OF THE VISCOELASTICITY OF MATERIALS. A. Sentis.
C.R. Acad. Sci. (Paris), Vol. 241, No. 12, 729-30 (Sept. 19, 1955). In French.

Stress-strain relations are proposed, to take account of delayed elasticity, flow, internal friction, etc., which differ from those of classical elasticity theory only by an additional factor $(1 + \tau\,\partial/\partial t)$ operating on all the strain terms, where τ is a constant coefficient. J.G.Oldroyd

539.374

1661. THE VISCOSITY OF METAL WIRES. C.Sălceanu.
C.R. Acad. Sci (Paris), Vol. 241, No. 12, 734-6 (Sept. 19, 1955). In French.

Measurements made on the damping of the torsional oscillations of a metal wire show the product of frequency and viscosity to be approximately constant. Viscosity (η) is calculated from the formula $\eta = 2.81I/\pi Tr^4$, where l is the length of the wire, I the moment of inertia of the system, T the time taken for the amplitude to fall by one half, and r the wire radius. A.J.Kennedy

539.374

1662. ON THE PLASTIC DEFORMATION OF α -BRASS SINGLE CRYSTALS BY COMPRESSION. H.Kimura.
J. Phys. Soc. Japan, Vol. 11, No. 1, 53-6 (Jan., 1956).

The relationship between the crystallographic orientation of specimens and easy glide was examined with α -brass single crystals deformed by compression. Micrographic observations were performed and discussed together. Besides these main studies, it was found that the hardening in copper alloys due to low-temperature annealing after cold working, which was observed in polycrystalline specimen, was not observed in single crystals. A.

539.389.3

1663. STRESS RELAXATION IN GOLD WIRE.
O.L.Anderson and P.Andreatch.
J. appl. Phys., Vol. 26, No. 12, 1518-19 (Dec., 1955).

The stress relaxation was measured by wrapping the wir under known tension around a "nickel silver" strip, and observing the twist in the strip as a function of time, over a period of 16 months, at various constant temperatures

25° C to 150° C). The activation energy associated with stress relaxation is deduced; it decreases with increasing stress, and the extrapolated value at zero stress agrees with the activation energy of Au self-diffusion. J.G.Oldroyd

539.43

1664. ON THE THERMAL ASPECT OF FATIGUE. A.M.Freudenthal and J.H.Weiner.
J.appl. Phys., Vol. 27, No. 1, 44-50 (Jan., 1956).

An attempt is made to show that the highly localized temperature and associated thermal stress gradients in front of active slip planes, resulting from the conversion into heat of the work in slip of the resolved shear stress, are of sufficient severity to account for the initiation of micro-cracks parallel to the slip planes if, as in fatigue, slip under repeated stress cycles is concentrated into "striations". The effect of the thermal characteristics of the metal on its fatigue performance is discussed. A.

539.533 : 539.219

1665. EFFECT OF DIRECTIONAL PRECIPITATION ON HARDNESS IN AN AGE-HARDENED ALLOY. T.Mitui.
J. Phys. Soc. Japan, Vol. 10, No. 10, 905-6 (Oct., 1955).

Anisotropy of hardness is found in specimens of Cu—2% Co after heat treatment in a magnetic field. The effects were marked after 5 hr at 750° C in fields of some thousands of oersted. After 15 hr at this temperature the effect disappears, suggesting that the field controls the orientation of the initial nuclei of precipitation. W.M.Lomer

539.58

1666. DYNAMIC DETERMINATION OF THE COMPRESSIBILITY OF METALS. R.W.Goranson, D.Bancroft, B.L.Burton, T.Blechar, E.E.Houston, E.F.Gittings and A.A.Landeen.
J. appl. Phys., Vol. 26, No. 12, 1472-9 (Dec., 1955).

Equation of state data for Duralumin in the pressure range from 0.1 to 0.3 megabar were determined dynamically by measuring shock and free surface velocity electrically in a plate of 24 ST Duralumin that had been stressed by a high explosive detonation. A theory is presented which allows comparison with data obtained by other experimenters, and which yields the relationship between pressure and compression either at constant entropy or constant temperature. The empirical form chosen for the equation of state expresses the pressure as a quadratic function of the compression. Experimental techniques are described in detail. Five points are given for the equation of state of Duralumin in the pressure range from approximately 0.15 megabar to 0.33 megabars. Some data are also presented for cadmium and steel. A.

539.62

1667. SOME RECENT EXPERIMENTS IN FRICTION.
Nature (London), Vol. 176, 944-7 (Nov. 19, 1955).

FRICTION OF SOLIDS AT HIGH SPEEDS. F.P.Bowden and E.H.Freitag. (944-6).

Peripheral speeds of 1000 m/sec were obtained with a steel ball spinning, in vacuo, in a rotating magnetic field, and the friction of the steel surface was measured by allowing the spinning ball to touch another surface (copper or bismuth) and observing the deceleration. At low sliding speeds (200 m/sec) the friction was high ($\mu = 1.7$), falling to $\mu = 0.2$ at 600 m/sec. Micrographs of the worn surface show transition from heavy wear at low speeds to small wear at high speeds, with evidence for extensive melting at higher speeds. The low friction is due to a molten metal film acting as a lubricant, analogous to water on ice.

FRICTION ON SNOW AND ICE AND THE DEVELOPMENT OF SOME FAST-RUNNING SKIS. F.P.Bowden (946-7).

Experiments on full-size skis with different surfaces (waxed wood, lacquered wood, Perspex, aluminium) confirm earlier observations on model skis that low kinetic friction is due to melting of ice by frictional heating. Static friction of all materials except polytetrafluorethylene (P.T.F.E.) is high ($\mu = 0.2 - 0.5$) except very near the melting point of ice. With P.T.F.E. very low friction was observed under all conditions, due partly to inherently good frictional properties, and partly to the fact that it is not wetted by water (contact angle 126°). Experimental runs show that P.T.F.E. skis run faster and more uniformly even on patchy snow. J.W.Menter

539.621

1668. AUTOCORRELATION ANALYSIS OF THE SLIDING PROCESS. E.Rabinowicz.
J. appl. Phys., Vol. 27, No. 2, 131-5 (Feb., 1956).

A simple model of the sliding process is developed in which the junctions are of the same size, but have different shear strengths, and, using an artificially obtained friction trace, it is shown that the size of the junctions may be deduced through a simple autocorrelation analysis. Applied to real friction traces obtained at slow sliding speeds, the technique gives an average junction diameter of 9×10^{-4} cm, in good agreement with previous estimates, while a different statistical method gives a value of 5×10^{-4} cm. A.

539.621

1669. VAPOR LUBRICATION OF GRAPHITE SLIDING CONTACTS. R.H.Savage and D.L.Schaefer.
J. appl. Phys., Vol. 27, No. 2, 136-8 (Feb., 1956).

A fundamental study of graphite sliding contacts shows that atmospheric concentrations of only a few parts per million of the larger organic molecules are sufficient to prevent the severe wear of graphite which occurs in a dry atmosphere. The experimental results suggest roughly the empirical rule that the minimum relative "humidity" of a vapour for effective lubrication decreases logarithmically with chain length in the region 5 to 15 A. A.

539.89 : 536.71

1670. GRÜNEISEN'S CONSTANT FOR SOME METALS. J.J.Gilvarry.
J. chem. Phys., Vol. 23, No. 10, 1925-7 (Oct., 1955).

The Grüneisen constants, as evaluated from compressibility parameters, are redetermined for the alkali metals Li, Na and K and are determined for Rb and Cs from experimental data of Bridgman, and are shown to be in good agreement with the corresponding values as evaluated from Grüneisen's law. In the cases of Au, Mo, Ta and Mn, previous work by Slater had shown a large discrepancy between these two evaluations of the Grüneisen constant. The discrepancy is largely removed for Au by a redetermination of the Grüneisen constant from more recent compressibility data of Bridgman. The disagreement persists for Mo (to some degree), and for Ta (where the disparity is large); the results for Mn are inconclusive. A redetermination for Al brings closer agreement than previously between the two evaluations of the constant. The bearing of the results for compressibility parameters on some semiempirical equations of state is indicated. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.12

1671. NOTE ON THE SIMPLE COLLISION THEORY OF BIMOLECULAR REACTIONS. R.D.Present.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 6, 415-17 (June, 1955).

A simple classical model is proposed for the formation of the activated complex, in which explicit account is taken of the potential energy of interaction and its relation to the activation energy, and which leads to an explicit expression for the reaction cross-section as a function of the total relative kinetic energy of translation. E.H.Sondheimer

541.123.5

1672. HETEROGENEOUS EXCHANGE BETWEEN CHEMISORBED HALOGEN AND METHYL HALIDE. R.Coekelbergs, A.Frennet, P.A.Gosselain and M.J.van der Venne.
J. chem. Phys., Vol. 23, No. 9, 1731-2 (Sept., 1955).

It is established that exchange between inorganic and organic chlorine may take place on metallic coatings, e.g. on tungsten, with an apparent activation energy of 20 to 25 kcal. There is no exchange reaction in Pyrex bulbs nor, at low temperature, on metallic coatings. W.Good

541.123.5 : 539.217

1673. STUDIES OF HIGH POLYMERS BY RADIOACTIVE METHOD. I. SELF-DIFFUSION OF IONS IN ION EXCHANGERS. S.Sugai and J.Furuichi.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1032-40 (Dec., 1955).

In order to study kinetic exchange reaction and self-diffusion of ions in ion exchangers, the rate of ion exchange was measured by radioactive tracer method similar to that employed by A.Langer, and Pitts' general theory of radioactive ion exchange was applied, with the focus of attention on the rate determining factor of reaction in each case, to analyse the results. When a concentrated external solution is used, diffusion of cation in cation exchangers and diffusion of anion in anion exchangers is thought to be the controlling factor, whereas in the case of a dilute external solution, the rate of exchange is probably controlled by surface diffusion. For the former case, diffusion coefficients, activation energy of diffusion, and activation entropy of diffusion were calculated; from the results obtained, the mechanism of diffusion in exchange resins was discussed. A.

541.124

1674. MECHANISM OF THE PYROLYSIS OF ETHYL BROMIDE. A NOTE ON A PAPER BY FRIEDMAN, BERNSTEIN AND GUNNING. A.Maccoll and P.J.Thomas.
J. chem. Phys., Vol. 23, No. 9, 1722 (Sept., 1955).

See Abstr. 3210 (1955). The possibility that the decomposition of ethyl bromide proceeds by a mixed unimolecular and radical-chain mechanism is discussed. W.Good

541.124

1675. COMMENTS ON THE C^{13} ISOTOPE EFFECT IN THE THERMODECOMPOSITION OF ETHYL BROMIDE.
H.L.Friedman, R.B.Bernstein and H.E.Gunning.
J. chem. Phys., Vol. 23, No. 9, 1722-3 (Sept., 1955).

See preceding abstract. Preliminary experiments on the photolysis of ethyl bromide in the presence of excess cyclopentane lead to the conclusion that the thermal decomposition is not unimolecular. The radical-chain mechanism is examined from the point of view of the isotope effect. W.Good

541.12

1676. THERMAL REACTION BETWEEN HYDROGEN AND NITROGEN DIOXIDE. P.G.Ashmore and B.P.Levitt.
Nature (London), Vol. 176, 1013-15 (Nov. 26, 1955).

Curves are given showing the rate of disappearence of NO_2 at 411°C. The concentration of the NO_2 was determined by a light-absorption technique which is briefly described. NO has a strong inhibiting effect; the effect of water vapour is slight except near the end of the reaction. Stoichiometrically the reaction appears to be $H_2 + NO_2 = H_2O + NO$; kinetically it is first-order with respect to NO_2; with respect to H_2 an order for the initial rate between 1 and 1.5 is suggested by the data. W.Goo

541.124

1677. THEORETICAL CALCULATION OF THE TIME DEVELOPMENT OF A BRANCHED CHAIN REACTION.
P.Blanquet.
J. Chim. phys., Vol. 52, No. 11-12, 826-8 (Nov.-Dec., 1955) In French.

The general-case solution is developed for the Bursian-Sorokin equation of branched chain reactions, the consumption of the reactants being duly allowed for. Formulae thus obtained are applied to the special case in which the branching factor is proportional to p^n, while the mean time of the formation of one chain link is proportional to p^{-1}, where p is the pressure giving the relative measure of the amount of unchanges reactants and n is the concentration of the active centres. F.Lachman

541 124

1678. KINETICS OF PROCESSES DISTRIBUTED IN ACTIVATION ENERGY. W.Primak.
Phys. Rev., Vol. 100, No. 6, 1677-89 (Dec. 15, 1955).

The kinetic behaviour of systems in which processes occu which are distributed over a range of activation energies is co sidered. The effects produced by the initial distribution, the order of reaction, and the frequency factor are discussed. Imaginary and actual experimental situations are used to illus trate the large errors which can result when the distribution of the processes in activation energy is neglected. Some of the complications which can result from successive reactions and varying frequency factors are mentioned. A

541.124 : 534.22/.23

1679. DISPERSION AND ABSORPTION OF SOUND IN IMPERFECT GASES IN GENERAL CHEMICAL EQUILIBRIUM AND ITS APPLICATION TO CHEMICAL KINETICS.
D.Tabuchi.
J. chem. Phys., Vol. 23, No. 11, 2033-7 (Nov., 1955).

Previously, it was shown that there occur dispersion and absorption of sound owing to chemical reaction in a gas in general chemical equilibrium such as

$$aA + bB + \ldots \rightleftarrows qQ + rR + \ldots .$$

As the velocity and the absorption coefficient of sound are affected predominantly by the imperfection of the gas, the case of imperfect gases is considered. The velocity and the absorption coefficient are derived from the complex velocity of sound, the characteristic of the dispersion and absorption curves are examined. The velocity and the absorption coefficient of sound are formulated in terms of the pressure, the density, the virial coefficients, the equilibriu constant, i.e., the composition, the reaction heat at a constant volume, the molar heat at a constant volume, and the rate constant of the chemical reaction. By measuring the velocity and the absorption coefficient of sound, it is possibl

o calculate the rate constant of the chemical reaction and the reaction heat. As special cases, the formulae for the perfect gas and for a mixture of imperfect gases in which no chemical reactions occur, are derived. As an example of the calculation, the case of the dissociation equlibrium $A \rightleftarrows B + B$ is treated. A.

541.124 : 539.155.2

1680. OXYGEN-18 ISOTOPE EFFECT IN THE REACTION OF OXYGEN WITH COPPER. R.B.Bernstein.
J. chem. Phys., Vol. 23, No. 10, 1779-802 (Oct., 1955).

The fractionation of O^{18} in the reaction of copper with oxygen of natural isotopic composition has been measured over the temperature range 68-256° C. The oxide films estimated thicknesses varying from 150-2500 A) were removed for O^{18} assay by treatment with hydrogen at 350° C. Using the CO_2 equilibration technique, the O^{18}/O^{16} ratios for the resulting water samples were determined mass spectrometrically and compared with the ratio for a reference sample of water prepared from the original oxygen gas. The direction of the fractionation indicated that O_2^{16} reacts preferentially compared to $O^{16}O^{18}$. The isotope effect appeared to be independent of the oxygen pressure over the limited range studied (2-25 cm Hg). The magnitude of the fractionation factor was 1.0% at 150° C, with a small negative temperature coefficient. From this it was possible to estimate a value of ΔE_{act} = 7 cal/mole, which may be compared with the calculated isotopic zero-point energy difference of 64 cal/ mole. The theoretical implications of the experimental results are discussed. A.

541.124 : 539.155.2

1681. EXAMINATION OF THE ISOTOPE EFFECT IN THE CONDENSATION OF o-BENZOYLBENZOIC ACID-CARBOXYL-C^{14} TO ANTHRAQUINONE-9-C^{14}. G.A.Ropp.
J. chem. Phys., Vol. 23, No. 11, 2196 (Nov., 1955).

It is suggested that the "reverse isotopic effect" found in this condensation by Stevens and Crowder (Canad. J. Chem., Vol. 32, 792-801, 1954) might have resulted from an isotopic dilution after synthesis of the acid. A normal isotopic effect was indicated when the condensation was studied by preparing radiochemically pure o-benzyl-benzoic acid-carboxyl-C^{14} and diluting this before oxidation to the benzoyl acid. W.Good

541.126

1682. MEASUREMENT OF THE VELOCITY OF COMBUSTION (OF GASES) BY THE SOAP-BUBBLE METHOD.
J.Lecamp and A.Sicard.
C. Phys. Radium, Vol. 16, No. 7, 69 S - 70 S (July, 1955).
In French.

Apparatus for the measurement of the velocity of combustion of mixtures of gases, more especially of mixtures of hydrocarbons and nitrous oxide, by the soap-bubble method, is described. The gas mixture is fired by a spark between two removable electrodes mounted at the centre of the bubble, and the velocity of the combustion zone is deduced from the rate of increase of the radius of the combustion wave-front and the rates of the initial and final volumes of the bubble. These determinations are made by a strioscopic-optical device giving a magnification of 3.73, and a continuously registering camera fitted with a rotating drum. A time base is provided by occultation of a luminous beam of frequency 2000 c/s. J.S.G.Thomas

541.126

1683. GENERATION OF SPHERICAL EXPLOSIVE (DETONATION) WAVES IN GASEOUS MIXTURES. H.Freiwald and A.Ude.
C.R. Acad. Sci. (Paris), Vol. 241, No. 12, 736-9 (Sept. 19, 1955). In French.

Spherical detonation waves have been initiated in a bulb of 30 cm dia. from a plane detonation wave in a brass tube containing the same mixture as the bulb. Detonation could not be obtained in any ratio of acetylene to air; detonation limits have been established for mixtures of acetylene and oxygen, propane and oxygen, and hydrogen and oxygen. Observations have also been made of the passage of combustion initiated by a spark into a stable or unstable detonation (depending on the amount of oxygen in the gas), the time to onset of detonation being measured. R.C.Murray

541.126

1684. SENSITIVITY OF EXPLOSIVES TO PURE SHOCKS. W.A.Gey and A.L.Bennett.
J. chem. Phys., Vol. 23, No. 10, 1979-80 (Oct., 1955).

Describes an apparatus designed to initiate the reaction of explosives by exposing them to uniform head-on shocks (see also Abstr. 561/1950) of Mach 5-7 for periods of 60-120 microsec. Lead styphnate followed closely by 4, 6-dinitrobenzene-2-diazo-1-oxide (DDNP) were found to be the most sensitive, while tetracene, nitrosoguanidine, PbN_6 and nitroglycerine were less sensitive. A diagram shows the relationship between the sensitivity and the density (exposed area) of the explosive for one lot of DDNP. F.Lachman

541.126 : 778.37

1685. STUDIES ON THE EXPLOSION MECHANISM OF ELECTRIC BLASTING CAPS BY ULTRA-HIGH-SPEED GRID FRAMING CAMERA. T.Uyemura and T.Morishige.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1064-7 (Dec., 1955).

The process of explosive fracture of the non-luminous subject has been distinctly photographed by the grid-type ultra-high-speed camera with the use of synchronized flash lighting. A description is given briefly of the equipment used and of some experimental results derived from the resulting photographs. A.

541.127

1686. OXIDATION OF METHANE WITH NITROGEN DIOXIDE. M.L.Bromberg and H.A.Taylor.
J. chem. Phys., Vol. 23, No. 12, 2399-403 (Dec., 1955).

The reaction of methane with nitrogen dioxide has been studied in a flow system at temperatures from 600°-900° C with contact times of about 10^{-2} sec and in a static system from 350°-400° C and a total pressure of 250 mm. Initial rates have been related empirically and a discussion of the possible reactions occurring is presented. A.

541.127

1687. EFFECT OF INITIAL TEMPERATURE ON MINIMUM SPARK-IGNITION ENERGY. I.R.King and H.F.Calcote.
J. chem. Phys., Vol. 23, No. 12, 2444-5 (Dec., 1955).

A set of curves for n-pentane—air mixtures is given which shows the influence of temperature on the variation of minimum spark-ignition energy with composition. Values of this energy for mixtures of stoichiometric composition are tabulated for a number of fuels. W.Good

541.127.1

1688. SERIES SOLUTIONS FOR THE RATE EQUATIONS OF COMPLEX REACTION MECHANISMS. J.C.Morrow.
J. chem. Phys., Vol. 23, No. 12, 2452 (Dec., 1955).

The use of a Taylor's series representing time as a function of concentration is suggested as a useful and powerful tool in the analysis of complex reaction systems where arbitrary relative values of the rate constants have to be considered. W.Good

541.128

1689. EFFECT OF V_2O_5 ON NICKEL—ZINC FERRITE FORMATION. D.M.Grimes, L.Thomassen, C.F.Jefferson and N.C.Kothary.
J. chem. Phys., Vol. 23, No. 11, 2205 (Nov., 1955).

Experimental. Addition of V_2O_5 decreases the firing temperature needed for ferrite formation from a mixture of NiO, ZnO and Fe_2O_3; 0.75 mole % V_2O_5 decreases the temper-

ature by 400° C for $Ni_{0.4}Zn_{0.6}Fe_2O_4$. Comparable effects were not observed for addition of other minor components.

J.Hawgood

541.128

1690. NITRIC OXIDE CATALYZED CIS-TRANS ISOMERIZATION OF DIDEUTEROETHYLENE. B.S.Rabinovitch and F.S.Looney.
J. chem. Phys., Vol. 23, No. 12, 2439-40 (Dec., 1955).

The energy of activation for the homogeneous reaction is found to be E = 27.5 kcal. This value may denote either (a) strong catalyst-substrate interaction (chemical catalysis), or (b) that E is closely related to the true energy of "crossing" of the singlet and lowest triplet states of ethylene. S.J.Gregg

541.128

1691. REMARKS ON NITRIC OXIDE CATALYZED CIS-TRANS ISOMERIZATION OF DIDEUTEROETHYLENE. H.M.McConnell.
J. chem. Phys., Vol. 23, No. 12, 2440 (Dec., 1955).

See preceding abstract. Where, as with catalysis by NO, there is strong interaction between the catalyst and the isomer, the quantum-mechanical repulsion between the two doublet states effectively "breaks" the C=C bond. It is also suggested that substances in singlet states can act as catalysts if they have low lying electronic states of higher multiplicity.

S.J.Gregg

ELECTROCHEMISTRY 541.13

541.133 : 537.311.35

STUDY OF THE CONDUCTIVITY OF CARBON TETRACHLORIDE (FIELDS < 1500 V*cm). See Abstr. 364.

541.135

1692. THEORY OF THE FARADAIC ADMITTANCE. III. APPLICATION OF DIFFUSION THEORY TO CURRENT-INTERRUPTER STUDIES. W.T.Scott.
J. chem. Phys., Vol. 23, No. 10, 1936-48 (Oct., 1955)

For Pt I, see Abstr. 7243 (1953). The problem of predicting and interpreting the potential v. time curves obtained in current-interrupter studies of electrochemical reactions is considered with reference to those cases in which diffusion in one or both phases plays a major role. Fick's laws of diffusion are solved in such a way as to provide a complete set of equations governing the current and potential across the interface and the concentrations of the active substances at the interface. These solutions are given for a plane, finite or effectively infinite, unstirred or boundary layer in which diffusion takes place, and for initially uniform or arbitrary gradients. Application is made to the case of a simple uncomplicated reaction and to the hydrogen discharge case, and the mathematical complexity of the latter is made evident. Some efforts are made to discuss the solution of the potential-time equation, and a procedure is given in the simpler case for evaluating the parameters of the process from experimental data. A mathematical appendix gives the application of the Laplace transform method to the solving of Fick's laws under transient conditions and to related aspects of the problem. A.

541.135

1693. IONIZATION OF STRONG ELECTROLYTES. IV. NUCLEAR MAGNETIC RESONANCE AND DISSOCIATION OF TRIFLUOROACETIC ACID. G.C.Hood, O.Redlich and C.A.Reilly.
J. chem. Phys., Vol. 23, No. 12, 2229-35 (Dec., 1955).

For Pt III, see Abstr. 3222 (1955). Proton and fluorine magnetic resonance of trifluoroacetic acid in water reflects the influence of electrolytic dissociation below a mole fraction 0.5 and of hydration above 0.5. The dissociation constant is estimated to be 1.8. A.

541.135.5

1694. OVERVOLTAGES IN MELTED ELECTROLYTES. R.Piontelli and G.Sternheim.
J. chem. Phys., Vol. 23, No. 10, 1971-2 (Oct., 1955).

See Abstr. 8347 (1955). Overvoltages at the interface of each of the metals Pb, Cd, Sn, Zn and their respective molten chlorides have, both from the anodic and cathodic side the character of pure ohmic drop. W.Good

541.135.5 : 548.51

1695. ELECTROLYTIC FORMATION OF NUCLEI ON SPHERICAL Pt SINGLE CRYSTAL ELECTRODES. R.Kaischew and B.Mutaftschiew.
Z phys. Chem. (Leipzig), Vol. 204, No. 5-6, 334-47 (Aug., 1955). In German.

The apparatus and method in a study of the electrolytic deposition of Hg and of Ag on spherical single crystals of Pt by a square-wave voltage impulse are described. The formation of nuclei on the Pt takes place at different velocities round the crystallographic poles of the octahedral and cubic surfaces. A brief interpretation of the results in the light of existing theory of nuclei formation is given. W.Good

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

1696. PHOTOCHEMICAL PROCESSES IN SOLIDS AT ROOM TEMPERATURE. R.A.Ford.
Nature (London), Vol. 176, 1023-4 (Nov. 26, 1955).

When thin Nylon polymer films are irradiated by an unscreened Hanovia S. 250 U mercury arc in the presence of oxygen, a new absorption band develops centred around 2900 A. A simple reaction scheme involving a peroxy radical responsible for the absorption at 2900 A is suggested to explain the phenomenon. W.Good

541.14

1697. HYDROGEN PEROXIDE PHOTOCATALYZED REACTION OF HYDROGEN AND OXYGEN. D.H.Volman.
J. chem. Phys., Vol. 23, No. 12, 2458-9 (Dec., 1955).

The postulate is tested that the high yields of water among the products, O_2, H_2O_2 and H_2O of the photochemical reaction of O_2 and H_2 at 1849 A can be explained by a photocatalyzed reaction of H_2 and O_2 in the presence of H_2O_2. It is found adequate. W.Good

541.14 : 535.343

1698. SHORT-LIVED SPECIES FROM THE PHOTOLYSIS OF AQUEOUS ALKALI HALIDE AND HALOGEN SOLUTIONS. L.I.Grossweiner and M.S.Matheson.
J. chem. Phys., Vol. 23, No. 12, 2443-4 (Dec., 1955).

Absorption bands (previously unreported) in the spectra of (helium swept) aqueous solutions of alkali halides or halogens were detected within 30 microsec after irradiation in a quartz cell using a 40 microsec, 1550 joule flash from a xenon lamp. It is suggested that the most likely primary product is the excited halide ion and that the bands are due to a secondary product (dihalide ion) of its reaction with halide ion. It is argued that solvated electrons may not be responsible.

W.Good

541.15

1699. SUCCESSIVE EXCITATION BY LOW-ENERGY ELECTRONS: GENERAL PRINCIPLE. M.Burton and J.L.Magee.
J. chem. Phys., Vol. 23, No. 11, 2194-5 (Nov., 1955).

A system is discussed theoretically in which free electrons of an average energy of 0.5-4 eV are introduced from an

external source. The molecules of the system are assumed to be in equilibrium in all degrees of freedom except electronic. The rate of energy input is kept small. It is possible to excite molecular electronic states of considerably higher energy than the average energy of the free electrons by moving the molecule up a succession of closer spaced electronic steps, provided radiative processes are slower than impact excitation of the states involved. Molecules may thus be brought up to a state at which decomposition is very rapid. The rate of decomposition of molecules by this mechanism would be proportional to the electron concentration. M.Ebert

541.15

700. SUCCESSIVE EXCITATION BY LOW-ENERGY ELECTRONS: APPLICATION TO ELECTRIC DISCHARGE IN METHANE. M.Burton and J.L.Magee.
J. chem. Phys., Vol. 23, No. 11, 2195-6 (Nov., 1955).

Acetylene is produced in high yields from methane by electric discharge. The Wiener–Burton reaction scheme (J. Amer. Chem. Soc., Vol. 75, 5815, 1953) is reconsidered. The new model steady-state process assumes methane to be decomposed by the overall reaction $CH_4 \sim\!\!\rightarrow \frac{1}{2}C_2H_2 + \frac{3}{2}H_2$ at a rate $r = \kappa I^{1/2}(CH_4)$ where I is the current and κ a constant. It is postulated that the free radical CH_2 has a ladder of 4 successive excitation processes, each followed by a number of chemical steps. This new reaction scheme allows for a maximum G (CH_4 decomposed) of approximately 50 and a linear relationship between the 4th excitation state of CH_2 and the current. M.Ebert

541.15

1701. EFFECTS OF GAMMA-RAYS ON SOLUTIONS OF SODIUM DEOXYRIBONUCLEATE. POSSIBLE CHEMICAL MECHANISM FOR THEIR BIOLOGICAL EFFECTS. R.A.Cox, W.G.Overend, A.R.Peacocke and S.Wilson.
Nature (London), Vol. 176, 919-21 (Nov. 12, 1955).

Aqueous solutions of deoxyribonucleate (0.17 - 0.43%) were irradiated with Co^{60} γ-rays (dose rates 1.1 to 1.3 x 10^{16} eV . min^{-1} . ml^{-1}), and their flow times were subsequently measured. The viscosities of the irradiated samples were independent of dose rate, R, for a given dosage, and depended only on ratio of dose to concentration. From the linearity of a plot of log (viscosity) against log (R) it is inferred that chain breakage is random. The results are interpreted on the basis of two breaks occurring in opposite positions, one in each of two polynucleotide strands of the double helix. Titration and ultraviolet absorption studies on the irradiated solutions give evidence that while hydrogen bonds are broken, some are still present holding the two helices together. The action of the γ-rays thus consists of (a) random cleavage of internucleotide phosphate ester bonds, and (b) rupture of cross-linking hydrogen bonds. The latter begins at doses lower than those which cause appreciable changes in intrinsic viscosity. It is suggested that the effect on hydrogen bonding shows a possible chemical mechanism for the biological (e.g. mutational) changes brought about by γ-radiation.
27 C.B.Allsopp

541.15

1702. ORGANIC RADIATION REACTIONS WITH DISSOLVED RADIOACTIVE IODINE. W.W.Miller, E.P.Rack, E.Burrell and C.N.Trumbore.
J. chem. Phys., Vol. 23, No. 12, 2457-8 (Dec., 1955).

I^{131} was used to induce reactions in mixtures of iodine and CCl_4, C_6H_{12}, C_2H_5I, or CS_2. The amount of organically bound not readily hydrolysable I was proportional to the radiation dose delivered to the solution by I^{131}. The rate of reaction of C_6H_{12} with I is probably zero order in I. The rate of reaction of I with CCl_4 is first order as regards I concentration. The reaction rate of C_2H_5I with I does not show simple dependence on I concentration. CS_2 was found to be extremely radiation-resistant, as judged by the lack of reaction with I. M.Ebert

541.15

1703. A CELL FOR KINETIC MEASUREMENTS OF GAS EVOLUTION FROM SYSTEMS IRRADIATED BY FAST ELECTRON BEAMS. C.B.Amphlett and T.F.Williams.
J. sci. Instrum., Vol. 33, No. 2, 64-5 (Feb., 1956).

By employing a mercury bellows manometer and balancing circuit it has been found possible to measure rapid rates of gas evolution from systems undergoing decomposition under fast electron bombardment from an electrostatic generator. The apparatus is reasonably robust, rapid in response and gives reproducible results. Much slower rates of gas evolution can also be measured by the same technique. A.

541.15 : 539.166.08

1704. YIELD OF THE FERROUS SULFATE RADIATION DOSIMETER: AN IMPROVED CATHODE-RAY DETERMINATION. R.H.Schuler and A.O.Allen.
J. chem. Phys., Vol. 24, No. 1, 56-9 (Jan., 1956).

A redetermination of the absolute yield G of ferrous sulphate oxidation by 2 MeV cathode-rays has been made with improved accuracy. The corrections for backscattering and charge transfer have been critically re-examined, the correction for absorption of energy in the windows has been determined experimentally and an improved method of determining the energy of the rays is described. The value of G is 15.45 $\pm$ 0.11 and is independent of radiation intensity. A.

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.182

1705. AN APPLICATION OF THE POISSON–BOLTZMANN EQUATION TO NONIDENTICAL, CHARGED PARTICLES. A.Bierman.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 4, 245-50 (July, 1955).

It is pointed out that the Verwey–Overbeek theory of the interaction of large charged particles immersed in an electrolytic medium cannot be applied to non-identical particles, and to remedy this a revised theory is developed in which the surface concentration of the potential-determining ion is included in calculating the chemical potential change. For identical particles the new theory gives the same expression for the force as does the Verwey–Overbeek theory, and it leads, moreover, to finite expressions for the force and charge density between two non-identical particles. Under certain conditions the new theory also predicts the existence of short-range attractive forces between particles which are both positively charged at large separation. E.H.Sondheimer

541.182.025

1706. NEGATIVE THIXOTROPY OF AQUEOUS SOLUTIONS OF POLYMETHACRYLIC ACID. J.Eliassaf, A.Silberberg and A.Katchalsky.
Nature (London), Vol. 176, 1119 (Dec. 10, 1955).

A several hundred-fold increase in consistency is easily induced by stirring or shaking in solutions of polymethacrylic acid of concentration 5-10% and degree of polymerization 10,000. The transformation is completely reversible. It is suggested that the phenomenon may be due to the fact that more intermolecular bonds are likely to be formed in a field of flow than in a system at rest. W.Good

541.182.2

1707. COLLECTION EFFICIENCY OF AEROSOL PARTICLES AND RESISTANCE TO FLOW THROUGH FIBER MATS. J.B.Wong, W.E.Ranz and H.F.Johnstone.
J. appl. Phys., Vol. 27, No. 2, 161-9 (Feb., 1956).

The collection efficiencies for sulphuric acid aerosols of 0.4 to 1.3 microns particle diameter, and the resistance to flow through glass fibre mats composed of 3.5, 6.2 and 9.6

micron fibres, were investigated experimentally. The results agree with the theory that particle collection in this range is a function of the inertia of the particles, the interception by the fibres, and the nature of the flow around the fibres, as characterized by the parameters ψ, R, and N_{Re}, respectively, and that the pressure drop is a function of the flow characteristics and the fibre interference effect. Theoretical equations for collection efficiency and pressure drop of fibre mats were analysed in terms of the impaction efficiency and drag coefficient of single fibres. These equations were evaluated by comparing the apparent fibre efficiency and drag with theoretical values. A.

541.183

1708. ADSORPTION OF AMMONIA ON SILICON. L.Miller.
Z. Naturforsch., Vol. 10a, No. 9-10, 801-2 (1955). In German.

The adsorption of ammonia is a measure of the number of hydroxyl groups on the surface of silica. This tool is used to prove that pure, degassed silicon is superficially oxidized by exposure to water vapour at room temperature. S.J.Gregg

541.183

1709. HEATS OF ADSORPTION ON A PREPARED UNIFORM SURFACE. W.A.Steele and J.G.Aston.
J. chem. Phys., Vol. 23, No. 8, 1547 (Aug., 1955).

The heat of adsorption of He at 14.5°K was measured on TiO_2, (a) bare, and (b) when covered with a half layer of argon. In (a) the heat of adsorption falls sharply, in (b) only slightly as surface coverage of the He increases from 0.0 to 0.5. This is evidence for surface heterogeneity; the pre-adsorbed argon smooths out surface roughnesses and fills in cracks. S.J.Gregg

541.183

1710. ADSORPTION AT THE SURFACE OF POLARIZED MERCURY IN CONTACT WITH AQUEOUS SOLUTIONS OF ORGANIC ACIDS. R.Grand.
Ann. Phys. (Paris), Vol. 10, 738-82 (Sept.-Oct., 1955). In French.

The interfacial tension γ of mercury against aqueous solutions of certain organic acids (I) has been measured for various concentrations c by a drop weight method; the applied voltage was usually zero (I was formic, acetic, propionic, n-butyric, oxalic, tartaric or citric). Amperometric and polarographic measurements have also been made. The curves of γ against log c and of i against log c (i = electrocapillary current) consist of linear portions separated by breaks or actual jumps in γ or i. From the results conclusions are drawn as to the ionization and the orientation of the adsorbed molecules; and the conclusions are confirmed by a comparison of the calculated dipole moments with the expected values. S.J.Gregg

541.183

1711. ADSORPTION STUDIES ON CLAY MINERALS. V. MONTMORILLONITE–CESIUM–STRONTIUM AT SEVERAL TEMPERATURES. G.L.Gaines, Jr and H.C.Thomas.
J. chem. Phys., Vol. 23, No. 12, 2322-6 (Dec., 1955).

For Pt IV see Abstr. 6095 (1954). Ion-exchange equilibria for the pair caesium–strontium between aqueous chloride solutions and a montmorillonite clay have been studied in the temperature range 5°-75°. Data from chromatographic elution experiments have been found to be unreliable because of nonequilibrium effects, and a method independent of rate behaviour has been applied. From the data obtained, equilibrium constants, solid-phase activity coefficients, heat content and entropy changes for the reaction have been evaluated. A.

541.183.5

1712. ADSORPTION OF He^3 AND He^4 ON ACTIVATED CHARCOAL. C.J.Hoffman, F.J.Edeskuty and E.F.Hammel.
J. chem. Phys., Vol. 24, No. 1, 124-30 (Jan., 1956).

The adsorption on activated charcoal of pure He^3 at 2.5 and 3°K, and of pure He^4 at 4°K has been measured. The volume of gas necessary to form a monolayer is approximately the same for the two isotopes. It is shown that capillary condensation does not occur in this adsorbent at low saturations. The data have been analysed by a number of methods with consistent results. A.

541.183.5 : 537.226.31

1713. TRANSFORMATION OF ADSORBED WATER ON SOLID SURFACES AND ITS DIELECTRIC LOSSES AND CONDUCTIVITIES. S.Kurosaki, S.Saito and G.Sato.
J. chem. Phys., Vol. 23, No. 10, 1846-50 (Oct., 1955).

The adsorption isotherm of water vapour on nonalkali glass cloth was obtained at 25°C, and its dielectric power factor was measured also in the frequency range of 80 kc/s - 11 Mc/s. The power factor of glass cloth and surface d.c. conductivities of nonalkali glass, soda glass, fused silica, Teflon, and polymethylmethacrylate plates increased rapidly to maximum when exposed to water vapour, and then gradually decreased to certain constant values. These phenomena may be interpreted as a physical picture of phase changes in the adsorbed water phase from the amorphous state to the crystalline state, as well as the deposit films of evaporated metals on solid surfaces. But the surface conductivity of polycapramide increases as the moisture content increases with time, suggesting a rapid absorption of water molecules into the solid. An analysis of this process of phase change of adsorbed water is outlined. A.

541.183.5 : 539.27

1714. THE ADSORPTION OF OXYGEN BY TUNGSTEN FROM OBSERVATIONS WITH THE FIELD ELECTRON MICROSCOPE. E.W.Müller.
Z. Elektrochem., Vol. 59, No. 5, 374-81 (1955). In German.

Summarizes recent work concerning the building up of the adsorbed layer at various temperatures, its migration over the surface and the influence on it of evaporation, reduction and desorption. J.Thewlis

CHEMICAL STRUCTURE 541.2/.6

541.62

1715. DYNAMIC EQUILIBRIUM OF INVERTED ISOMERS IN A CRYSTALLINE PHASE. T.Yoshino.
J. chem. Phys., Vol. 23, No. 10, 1974 (Oct., 1955).

The abundance ratio of the two rotational isomers of trans-1, 4 dichlorocyclohexane in the crystalline state has been determined at various temperatures. A large change in mole ratio with temperature was observed. G.I.W.Llewelyn

541.64 : 541.24

1716. APPARENT MOLECULAR WEIGHT OF POLYTRIFLUOROCHLOROETHYLENE. A.Nishioka and R.Koyama.
J. Phys. Soc. Japan, Vol. 11, No. 2, 139-44 (Feb., 1956).

To clarify the accuracy and physical basis of the two methods, NST and ZST, giving the apparent molecular weight of polytrifluorochloroethylene, some experiments were made by statistical means and their variances were analysed. Theoretical relations were derived between these apparent molecular weights and true average molecular weight by a simple model. The observed tendency of the experimental results between NST and ZST are qualitatively in accordance with the theoretical relations. A

541.651

1717. THERMOCHROMISM AND PHOTOCHROMISM. Y.Hirschberg and E.Fischer.
J.chem. Phys., Vol. 23, No. 9, 1723 (Sept., 1955).

A reply to the challenge made by Kortüm et al.(Z. phys.

hem., Vol. 2 (New Series), 179, 1954), that the conclusion at dyes formed both in thermochromism and in photochromism e identical, is not a valid one. W.Good

541.651

718. THERMOCHROMISM AND PHOTOCHROMISM.
Kortüm, W.Theilacker and V.Braun.
chem. Phys., Vol. 23, No. 9, 1723-4 (Sept., 1955).
It is still argued that the conclusion about the identity the dyes (see preceding abstract) is not a valid one.
W.Good

541.67

719. DIAMAGNETISM OF THE METHYLENE GROUP AND OLECULAR STRUCTURE. R.M.Mathur and C.R.Kanekar.
sci. industr. Res., Vol. 14B, No. 7, 357-8 (July, 1955).
The molar diamagnetic susceptibility of the CH_2 group has een deduced from measurements on (a) hydroxy coumarins nd their methoxy derivatives, and (b) coumarins and their ethyl derivatives. The difference in the values of χ_{CH_2} in e two series of compounds is attributed to the ionic character the CO bond in the methoxy compounds. G.I.W.Llewelyn

CHEMICAL ANALYSIS 543/545

545.8 : 539.16.08

720. STUDY OF SOME PHENOMENA OBSERVED ON METLLIC SPECIMENS IRRADIATED IN AIR BY DEUTERONS OF BOUT 3 MeV. A.Kohn and J.Doumerc.
Phys. Radium, Vol. 16, No. 8-9, 649-53 (Aug.-Sept., 1955). French.
An investigation has been made of possible sources of rror in the estimation of the carbon content of specimens of on by the deuteron bombardment method (Abstr. 1234/1953). arious experimental precautions are recommended, the prinipal object being to avoid adsorption by the specimen of radioctive gases from the air. J.J.Wilkins

545.8 : 539.172.4

1721. DETERMINATION OF CHROMIUM, VANADIUM AND TUNGSTEN BY ACTIVATION ANALYSIS USING LOW-LEVEL NEUTRON SOURCES. M.Huaringa.
Nature (London), Vol. 177, 85 (Jan. 14, 1956).
Chromium, vanadium and tungsten were precipitated by silver nitrate in neutral solution as silver chromate vanadate and tungstate. The precipitates were collected on flat, circular Plexiglas disks. These disks were exposed to a 270 mg Ra–Be source for 10 minutes, and the induced radioactivity was estimated with a thin-window G.M. counter. Radioactivity was induced only in silver and vanadium. This method, once calibrated for known amounts of silver salts, allows a quick and easy analysis of chromium, vanadium and tungsten, using small Ra–Be neutron sources. M.Ebert

545.824

1722. X-RAY PHOTOELECTRON SPECTROMETER WITH ELECTROSTATIC DEFLECTION. R.G.Steinhardt, Jr, F.A.D.Granados and G.I.Post.
Analyt. Chem., Vol. 27, No. 7, 1046-56 (July, 1955).
Describes the design and operational characteristics of an improved X-ray photoelectron spectrometer intended for rapid, precise and convenient chemical analysis of surfaces and subsurface regions of solids. Replacement of the magnetic analyser by a radial, inverse first-power, electrostatic field analyser has resulted in considerable improvement in performance. The resolution has been improved by a factor of 5, and the inherent intensity has been increased by a factor of about 20. Variable slit widths make it possible to vary the resolution by a factor of 8, leading to a considerable potentiality for versatility. Other refinements decrease the time of a routine determination from 2 to 4 hours to less than 10 minutes. A.

545.84 : 537.362

PHENOMENOLOGICAL RELATIONS OF ELECTRO-OSMOSIS IN PAPER ELECTROCHROMATOGRAPHY. See Abstr. 386.

CRYSTALLOGRAPHY 548

548.5

723. ORIENTED Ag_2S OVERGROWTHS ON SILVER-CTIVATED CdS SINGLE CRYSTAL. K.T.Wilke.
aturwissenschaften, Vol. 42, No. 22, 603-4 (1955). In erman.
Ag can be included in the CdS lattice on sublimation of a dS–Ag_2S mixture up to 5×10^{-5}% by weight. At higher conentrations the Ag_2S separates out as oriented overgrowths the CdS crystals. The structure of these overgrowths e described for concentrations of between 6×10^{-5} and $^{-2}$% Ag. J.Franks

548.5

724. (METAL) SINGLE CRYSTALS WITH PURE SURFACES.
.Menzel, W.Stössel and M.Otter.
Phys., Vol. 142, No. 3, 241-4 (1955). In German.
The metal (Pb, Cu, Ag or Au) is heated in vacuo well ove its melting point on a flat W or Mo strip heater and then lowed to cool, when it forms into drops which solidify from e side into a pure single crystal. Impurities are pushed to the melt as in zone melting. Stages in the crystallization Cu are illustrated. S.Weintroub

548.5

1725. GROWTH SPIRALS IN ELECTRODEPOSITED COPPER. H.J. Pick.
Nature (London), Vol. 176, 693 (Oct. 8, 1955).
Two types of spiral occur according to whether an acid or a neutral N/2 copper sulphate bath is used. The rate of growth appears to vary with crystallographic direction for the former but not for the latter. The copper was deposited with an average current density of 10 mA/cm^2 on a cold-rolled annealed polycrystalline copper sheet in which most of the grains were oriented with their (100) planes parallel to the sheet surface and their [001] directions parallel to the rolling direction. S.Weintroub

548.5

1726. FIBROUS GROWTH OF $NaClO_3$ ON SINGLE CRYSTAL. N.Kato.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1024-5 (Nov., 1955).
The $NaClO_3$ single crystals, grown from a seed crystal in a saturated solution at $30 \pm 1^\circ$ C, were bounded by {100} planes. Fibrous growth could occur on the crystals when contained in a dessicator. Moisture around the crystals is an important condition for fibrous growth. The direction of the

fibre axis relative to crystallographic axes of the base crystal was studied and the directions which vary with temperature are tabulated. X-rays revealed that the fibres, 1-10 mm long and several μ thick, have the same structure as the base crystal but consist of 0.5 mm long crystallites. Growth takes place at the tips of the fibres. S.Weintroub

548.5 : 539.234

ON THE CRYSTALLIZATION OF EVAPORATED LAYERS OF ANTIMONY. See Abstr. 721.

548.53 : 537.311.33

PREPARATION AND ELECTRICAL PROPERTIES OF InP AND GaAs. See Abstr. 347.

548.57 : 531.754.5

1727. DENSITIES AND IMPERFECTIONS OF SINGLE CRYSTALS. A.Smakula, J.Kalnajs and V.Sils.
Phys. Rev., Vol. 99, No. 6, 1747-50 (Sept. 15, 1955).

The densities of Si, Al, CaF_2, CsI, Ge, TlCl, TlBr and SiO_2 (quartz) have been computed from lattice constants and molecular weights obtained from International Atomic Weights, and compared with the densities as determined by hydrostatic weighing of large single crystals. (Abstr. 103/1956). The hydrostatic density of Ge proves too large by 0.00193. This discrepancy disappears when the mass-spectroscopic atomic weight is used for the density calculation. Also for Si, Al, and CaF_2 a better agreement results with mass-spectroscopic atomic weights. Therefore, it is concluded that the mass-spectroscopic atomic weights are more reliable than the officially accepted ones. From measured densities and lattice constants of Si, Al, CaF_2, and Ge, Avogadro's number is obtained as $6.023\,68 \times 10^{23}$ mole $^{-1}$ (chemical scale). The relative density defects for samples of Si, Al, CaF_2, and Ge proves to be negligible within the limit of the measurements ($< 5 \times 10^{-6}$), these crystals being the most perfect so far obtained. A somewhat higher relative density defect in quartz (11×10^{-6}) may be caused by uncertainty of the data used for the computation of the density and that for CsI (13×10^{-6}) by Rb contamination. TlCl and TlBr show the greatest relative density defects, 43×10^{-6} and 40×10^{-6} respectively. These crystals may contain vacancies or dislocations in the order of $\sim 5 \times 10^{18}$ per cm^3, as is known also for the silver halides. A.

548.574 : 537.311.33

1728. ELECTROLYTIC ETCHING AT SMALL-ANGLE GRAIN BOUNDARIES IN GERMANIUM. S.G.Ellis.
Phys. Rev., Vol. 100, No. 4, 1140-1 (Nov. 15, 1955).

There is a difference of appearance between n-type and p-type germanium crystals which have been anodically etched. This can be explained if only the hole current contributes to the etching. An n-type crystal can be made to etch in the same way as a p-type crystal if injected holes reach the crystal–electrolyte interface. Hole–electron recombination within the crystal can then reduce the rate of etching. Such recombination at small-angle grain boundaries has been demonstrated. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

1729. STATISTICAL PROPERTIES OF LATTICE CHAINS. E.Teramoto, M.Kurata, R.Chûjô, C.Suzuki, K.Tani and T.Kajikawa.
J. Phys. Soc. Japan, Vol. 10, No. 11, 953-9 (Nov., 1955).

The statistical problems of chains are divided into three classes, i.e. ideal type, real type and production type; these are investigated by the use of relatively short lattice chains. Complete enumeration of the dimensions of two-dimensional square-lattice chains up to bond number N = 20, and three-dimensional simple cubic-lattice chains up to N = 8, was carried out. As for the mean square end-to-end distance $\langle R_N^2 \rangle$, it was found that chains of real type always have larger values of $\langle R_N^2 \rangle / N$ than those of production type chain and the value seems to diverge as $N \to \infty$. The distribution of the end-to-end distances has a form which appreciably deviates from that of Gaussian distribution. A study is also made of the total number of configurations of lattice chains. A.

548.

1730. THE ORIENTATION OF RADIATING DIPOLES IN CRYSTALS OF LOW SYMMETRY. K.H.Hellwege.
Z. Phys., Vol. 143, No. 3, 340-7 (1955). In German.

For crystals of higher symmetry the orientation follows from the selection rules, but for monoclinic and triclinic crystals a knowledge of the eigenfunctions is necessary. For even numbers of electrons the magnetic dipoles in crystalline salts of rare earths are proved to lie in well defined directions in the crystal lattice. C.Turne

548

1731. SCATTERING OF NEUTRONS BY PHONONS IN AN ALUMINIUM SINGLE CRYSTAL. B.N.Brockhouse and A.T.Stewart.
Phys. Rev., Vol. 100, No. 2, 756-7 (Oct. 15, 1955).

A monochromatic beam of slow neutrons was obtained from a crystal spectrometer at the Chalk River pile. The beam was inelastically scattered from an aluminium single crystal at angles which did not satisfy the Bragg condition for elastic scattering, and the resulting neutrons were observed with the help of a second crystal spectrometer. The inelastic scattering involved the excitation or de-excitation of acoustic vibrations in the crystal. A study of the energy lost or gained by the neutrons enables the frequency of the acoustic waves to be examined as a function of their wave numbers and polarizations. J.M.Casse

548.

1732. SOME CHARACTERS OF THE SOAP BUBBLE RAFT IN A VIBRATING STATE. E.Fukushima and A.Ookawa.
J. Phys. Soc. Japan, Vol. 10, No. 11, 970-81 (Nov., 1955).

The bubble raft is set in a vibrating state in order to approximate the real crystal in thermal vibration more precisely by the model. The exciting vibration of 90 c/s is transmitted to the bubble raft through the sustaining liquid. In the vibrating state, it is observed that the bubble raft expands uniformly until a critical state is reached, where the regular alignment is destroyed abruptly. By means of lattice expansion, a formula is proposed defining a reduced temperature of the bubble raft corresponding to each input power of vibration. The diffuseness of the irregularity characteristic of lattice imperfections, such as the vacancy, the vacancy group, the interstitial and the dislocation, is observed to increase in general under vibration. In the case of the vacancy group, the stacking faults characteristic to the bubble raft can be detected. There is some preliminary discussion of the cause of the raft expansion and of diffused lattice imperfections, characteristic of the disordered state at the critical point, and the geometrical mechanism of formation of the stacking faults by means of imperfect dislocations. A

548.

1733. ON THE THEORY OF THE ELECTRICAL TRANSITIONS IN ALKALI HALIDES. I. THE EXCHANGE INTERACTION POTENTIAL BETWEEN FAST ELECTRONS AND LATTICE VIBRATIONS IN POLAR CRYSTALS. R.Veelken.
Z. Phys., Vol. 142, No. 4, 476-92 (1955). In German.

The calculation of the transition field strength requires knowledge of the exchange potential between conduction electrons and lattice vibrations. This quantity can be found by

sing the concept of fixed ions whose rate of polarization by he field can be allowed for. The formulae obtained are valid or the acoustic and optical modes and enable a distinction to e drawn between the polar and non-polar parts of the exchange otential. They also give the required conditions for the mklapp process. C.A.Hogarth

548.7

734. ON THE THEORY OF THE ELECTRICAL TRANSITIONS IN ALKALI HALIDES. II. CALCULATION OF THE ELECTRON DAMPING; NUMERICAL RESULTS. R.Veelken. Z. Phys., Vol. 142, No. 5, 544-57 (1955). In German.

Continues the calculations of Pt I and compares the results with experimental data for eight different salts. The effective masses of the electrons are thereby derived. C.A.Hogarth

548.7

735. INFLUENCE OF TEMPERATURE AND PRESSURE ON THE CRYSTALLINE FIELD AND ELECTRONIC LEVELS OF Eu–Zn NITRATE. K.H.Hellwege and W.Schröck-Vietor. Z. Phys., Vol. 143, No. 4, 451-64 (1955). In German.

Analysis of the spectrum was given earlier (Abstr. 0034/1954), but the shift of the absorption lines dependent on temperature and pressure is measured and used for calculating the matrix elements of the crystalline field. Both the thermal contraction and the compression are very anisotropic. C.Turner

548.7

736. SOME OBSERVATIONS ON DISLOCATIONS IN COPPER CRYSTALS. H.Suzuki. J. Phys. Soc. Japan, Vol. 10, No. 11, 981-95 (Nov., 1955).

Well-developed octahedral [111] and cubic [100] faces have been obtained in recrystallized copper by annealing the material at a temperature close to the melting point. Monatomic steps on both octahedral and cube surfaces, which were caused by the presence of dislocations and their motion, are visible through the decoration by oxide particles formed in the course of cooling. Arrays of dislocations in sub-boundaries, random migration of each dislocation, the migration of dislocation groups in sub-boundaries, and evaporation spirals are observed. Analysis of the structure of sub-boundaries in terms of constituent dislocations seems to support the main idea of the theory of dislocation network put forward by T. Suzuki and the present author. A.

548.7

737. OBSERVATIONS OF DISLOCATIONS ALONG GRAIN BOUNDARIES IN GERMANIUM CRYSTALS. J.Okada. J. Phys. Soc. Japan, Vol. 10, No. 11, 1018-19 (Nov., 1955).

Studies of etch-pit distributions on [100] faces of Ge, etched with CP-4. The results suggest that there is a one-to-one correspondence between etch pits and edge dislocations so far as grain boundaries are concerned. Etch pits distributed randomly are in edge orientation. C.A.Hogarth

548.7

738. ON THE COUPLED DISLOCATIONS ALONG A GRAIN BOUNDARY. Y.Uemura. J. Phys. Soc. Japan, Vol. 10, No. 11, 1020-2 (Nov., 1955).

The separations of the doublets, triplets and quartets of the etch pits along the boundary, using a simple model of pure edge dislocations in an isotropic elastic medium, are estimated in order to investigate the origin of forces which determine the patterns indicative of coupled dislocations. The forces which determine the separation of coupled dislocations arise from the elastic interaction between edge dislocations. C.A.Hogarth

548.7

739. DISLOCATION ENERGIES IN NaCl. H.B.Huntington, E.Dickey and R.Thomson. Phys. Rev., Vol. 100, No. 4, 1117-28 (Nov. 15, 1955).

The energies for both screw and edge dislocations in rock salt have been investigated. The effect of elastic anisotropy has been incorporated into the contribution from the region outside the core. Detailed calculations have been carried out for the energies of the cores themselves as a function of radius, and joined smoothly to the curves of the elastic theory. The core calculations are based on the Born–Mayer model and employ the formulae of Madelung for the potentials of rows of uniformly spaced charges. For dislocations in the observed plane of slip (110), the constant term associated with the core energy is 1.0×10^7 eV/cm more for the edge than for the screw. Approximate calculations show this term to be appreciably larger for the edge dislocation in the (100) plane. Also, there appears to be large lattice potential barrier for dislocation motion in this plane arising from anion closed shell repulsion. This result may explain why these planes, though close packed, are generally not active in glide for alkali halides. The stability of dislocations with Burger vector longer than the minimum lattice translation is investigated. The possibility of hollow dislocations is also considered. A.

548.7

1740. DETECTION OF VACANCIES CREATED BY X-RAYS IN SODIUM CHLORIDE. H.W.Etzel. Phys. Rev., Vol. 100, No. 6, 1643-5 (Dec. 15, 1955).

The creation of vacancies in sodium chloride by X-rays was detected using optical techniques. The F-band absorption produced by ultraviolet irradiation was measured and the band was then optically bleached. The crystal was then X-rayed and optically bleached. The crystal was again subjected to the same ultraviolet radiation as it received prior to X-raying, and the optical absorption of the F-band is remeasured. It was found that the sensitivity of a single crystal of NaCl to ultraviolet radiation was enhanced by a factor of 100 after it has been exposed to 40 kVp X-rays at 13 milliamperes for 30 minutes. Experiments were also performed to determine the stability at room temperature of the excess vacancies under visible and ultraviolet radiation. A.

548.7

1741. NUCLEAR MAGNETIC RESONANCE STUDIES OF IMPERFECT IONIC CRYSTALS. F.Reif. Phys. Rev., Vol. 100, No. 6, 1597-606 (Dec. 15, 1955).

The method of nuclear magnetic resonance is applied to the study of ionic crystals containing point defects, i.e., vacancy, interstitial, or impurity ions. Experiments are described which show that the presence of such defects can have marked effects on the resonance line and can lead to a complicated temperature dependence of its width. A brief theoretical discussion is given of two effects important if the nucleus whose resonance is observed has a large electric quadrupole moment: (1) line width due to static second-order quadrupole interaction with defects, and (2) contribution to the nuclear relaxation time T_1 by quadrupole interaction with fluctuating electric fields caused by diffusing defects. Experimental results on the Br resonance in AgBr are analysed in detail in terms of these effects. It is shown that the quadrupolar relaxation time due to diffusing defects in this salt can become sufficiently short to cause lifetime broadening of the resonance line, in particular that the motion of Ag vacancies seems to lead to a characteristic minimum of T_1 at about 0°C. The data also give some evidence for the association of defects in AgBr below 200°K. Cases of motional narrowing of the resonance line caused by the diffusion of defects are illustrated by experimental results on NaCl and LiBr. The existence of the various effects discussed in connection with these experiments indicates that nuclear resonance techniques can provide a means of studying the behaviour of point defects in solids, their motion and in some cases their association, from a rather microscopic point of view. The desirability of careful relaxation time measurements is pointed out. A.

548.7

1742. STRUCTURE SENSITIVITY OF THE X-RAY COLORATION OF NaCl CRYSTALS. R.B.Gordon and A.S.Nowick.
Phys. Rev., Vol. 101, No. 3, 977-83 (Feb. 1, 1956).

Room temperature measurements of the rate of colouring of NaCl crystals by X-rays at different depths below the irradiated surface and for different states of deformation and heat treatment are reported. From the results it is concluded that two mechanisms of colouring operate in these crystals. The first, or "rapid-type" colouring, approaches a saturation density of F-centres of the order of $10^{17}/cm^3$, and appears to result from the generation of colour centres from vacancies already present in the unirradiated crystal. The second, or "slow-type" colouring, takes place at a constant rate until F-centres in excess of $10^{18}/cm^3$ are formed. This type of colouring, which is usually observed only near the irradiated surface, is due to the generation of F-centres at dislocations, and is responsible for the hardness and density changes produced by the X-rays. Rapid-type colouring is found to occur at essentially the same rate in deformed crystals and in carefully annealed crystals; recovery at low temperatures after deformation, however, decreases the colourability. These results indicate that the principal effects of deformation and heat treatment on colourability may be related to the state of dispersion of impurities. A.

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.733

1743. DIFFRACTED-BEAM MONOCHROMATIZATION TECHNIQUES IN X-RAY DIFFRACTOMETRY. A.R.Lang.
Rev. sci. Instrum., Vol. 27, No. 1, 17-25 (Jan., 1956).

Four techniques using curved-crystal focusing monochromators are described: combinations of a reflection specimen and reflection monochromator, a reflection specimen and transmission monochromator, a transmission specimen and reflection monochromator, and a transmission specimen and transmission monochromator. The first technique allows recording of diffraction patterns due to $K\alpha_1$ radiation only, and elimination of Compton-scattered radiation (except at low angles). The second technique provides a back-reflection diffractometer for measurements at Bragg angles up to 90°. The third technique can be applied to weakly absorbing specimens when a strictly monochromatic diffraction pattern is required. Various aspects of the focusing geometry are analysed. A.

548.733

1744. X-RAY DIFFRACTION CAMERA FOR STUDYING LIQUIDS AT HIGH TEMPERATURES. J.(G.)Zarzycki.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 480-1 (Aug. 1, 1955). In French.

A drop of liquid rests in a small hole in a horizontal Pt-Rh plate which can be heated electrically; an X-ray beam from a monochromator passes vertically through the drop and is focused on a film below. The camera has been used for study of glass structure up to 1600° C. A.R.Stokes

548.733

1745. SINGLE QUARTZ CRYSTAL POINT FOCUSING X-RAY MONOCHROMATOR. D.W.Berreman.
Rev. sci. Instrum., Vol. 26, No. 11, 1048-52 (Nov., 1955).

A monochromator which uses Bragg reflection from a single lamina of quartz, bent in such a way that its atomic planes are given two principal radii of curvature, has been constructed for use in low-angle diffraction studies. It was found that the crystal reflects 2.78% of the incident Cu $K\alpha_1$ radiation into a converging beam one metre long, with a resolution of better than half a millimeter except for a very faint halo. The instrument has been used to obtain diffraction patterns from normal and sickle-cell human haemoglobin and also from southern bean mosic virus. The speed of the present instrument is roughly two hundred times that of an equivalent pinhole collimating system. A similar but still faster instrument is being constructed. A

548.73

1746. THE MEASUREMENT OF SPECIMEN TEMPERATURE IN A HIGH TEMPERATURE X-RAY POWDER CAMERA. R.S.Pease.
J. sci. Instrum., Vol. 32, No. 12, 476-80 (Dec., 1955).

Errors of specimen temperature measurement by means of thermocouples placed near the specimen are examined theoretically and experimentally for the case of an evacuated Unicam camera, where the furnace arrangements can be regarded as an imperfect radiation bath. Errors which increase monotonically with temperature arise because the radiation temperature of the furnace is not everywhere the same. Errors which are of opposite sign, and which increase to a maximum at about 200° C and then decrease with increasing temperature, arise because of conduction down the thermocouple leads. Design requirements to minimize the errors and keep them constant from one specimen to another are given. A

548.73

1747. X-RAY FANNING-OUT IN CALCITE. G.Borrmann, G.Hildebrandt and H.Wagner.
Z. Phys., Vol. 142, No. 4, 406-14 (1955). In German.

Describes theory and observations of the fanning-out of Mo-K α radiation in calcite, both in the Laue case and the Bragg case. A.R.Stoke

548.734 : 536.58

1748. THE CALIBRATION OF MICROTHERMOSTATS FOR X-RAY MEASUREMENTS ON CRYSTALS. J.C.McC.Pollock.
Acta cryst., Vol. 8, Pt 10, 652-3 (Oct., 1955).

Pure lead is considered to be one of the best crystals for calibrating a thermostat by measuring the spacing of a given set of planes. Values of the 620 spacing have been determine between -183° C and 22° C. A.R.Stoke

548.73

1749. A STUDY OF THE ATOMIC SCATTERING FACTOR FOR ALUMINIUM. G.S.Parry.
Acta cryst., Vol. 8, Pt 9, 593-4 (Sept., 1955).

New values are calculated on the basis of Viervoll and Ogrim (Abstr. 7445/1949) and earlier authors. The new values differ somewhat from previous ones when $\sin\theta/\lambda$ is less than 0.25 A^{-1}. A.R.Stokes

548.736.3 : 536.424

1750. X-RAY CRYSTALLOGRAPHIC STUDY OF PHASE TRANSFORMATION OF BORAX DURING THERMAL TREATMENTS. D.R.Dasgupta and B.K.Banerjee.
J. chem. Phys., Vol. 23, No. 11, 2189-90 (Nov., 1955).

These studies were made on samples of the decahydrate which had been dehydrated at various temperatures up to 750° C: pentahydrate was formed for temperatures between 50° C and 320° C, with some reversible formation of an amorphous phase. Above 320° C only the latter was present, and near 675° C it crystallized, to a form identified as anhydrous $Na_2B_4O_7$, of orthorhombic symmetry with a = 6.468 A b = 8.720 A and c = 11.54 A, in the space group $p/222_1$, with molecules per unit cell. J.Hawgoo

548.736

1751. STUDY OF PHASE TRANSFORMATION OF ORTHOBORIC ACID BY X-RAY DIFFRACTION METHOD.
D.R.Dasgupta and B.K.Banerjee.
J. chem. Phys., Vol. 23, No. 11, 2190-1 (Nov., 1955).

Orthoboric acid is triclinic, changing at 100-125° C to metaboric acid, tetragonal. The cell dimensions and parameters are given. Above 140° C bands occur, belonging to B_2O_3 glass. C.Turne

548.736.4 : 536.424.1

752. ORDER–DISORDER TRANSITIONS IN THE ALKALI BOROHYDRIDES. C.C.Stephenson, D.W.Rice and W.H.Stockmayer.
J. chem. Phys., Vol. 23, No. 10, 1960 (Oct., 1955).

λ-points analogous to that at 190°K in $NaBH_4$, corresponding to re-orientation of the BH_4^- ions from the low-temperature tetragonal structure to f.c.c., have been detected for the other alkali borohydrides, at temperatures, in deg K, of 76 ± 1 for K, of 44 ± 3 for Rb, and 27 ± 1 for Cs. This variation is of the form to be expected if the energy difference between the structures is mainly determined by the overlap of the BH_4 ions. J.Hawgood

548.737

753. DETERMINATION OF THE ORIENTATION OF ORGANIC MOLECULES BY MEANS OF DIFFUSE X-RAY SCATTERING. W.Hoppe.
Naturwissenschaften, Vol. 42, No. 17, 484 (1955). In German.

The diffuse X-ray scattering which occurs between the directions indicated by Bragg's law gives information about the orientation of molecules in crystals of organic compounds. The orientation can be deduced even when the crystals do not possess either a layer structure or a chain structure. Fuller details of the methods and some applications are to be published later. J.Iball

548.74

1754. ENERGY ANALYSIS OF KIKUCHI LINES. H.Watanabe.
J. Phys. Soc. Japan, Vol. 10, No. 10, 908-9 (Oct., 1955).

Kikuchi lines from a crystal of molybdenite of thickness about 250 A are studied by an electron velocity analyser of the Möllenstedt type and it is found that, although inelastic scattering plays a large part in the production of such lines, thermal scattering also makes a contribution. J.Thewlis

548.74

1755. SINGLE-CRYSTAL NEUTRON ANALYSIS OF TETRAGONAL $BaTiO_3$. B.C.Frazer, H.R.Danner and R.Pepinsky.
Phys. Rev., Vol. 100, No. 2, 745-6 (Oct. 15, 1955).

Neutron diffraction is used to determine the exact positions of the Ti and O atoms, which cannot be done by X-rays owing to the high scattering power of Ba. A structure is obtained which lies between the two alternative structures found by Evans on the basis of unpublished X-ray measurements. J.Thewlis

GEOPHYSICS 55

550.361

756. THE THERMAL HISTORY OF THE EARTH. A.Jacobs and D.W.Allan.
Nature (London), Vol. 177, 155-7 (Jan. 28, 1956).

The equation of heat conduction for a radioactive earth has been solved with the aid of an electronic computer by treating the problem in two parts, (1) cooling of the earth from its initial temperature, (2) heating due to radioactivity. Four initial temperature curves for the earth and four for heating due to radioactivity were considered. The results of two combinations of these are shown by curves and discussed. It is concluded that (1) all the models of the earth studied indicate that the temperature at depth has continued to increase throughout geological time, the temperature at the core boundary having increased most probably by about 300°C, (2) although radioactivity plays a major part in the thermal history of the earth, the initial distribution of temperature dominates thermal conditions at depth and near the surface for the first 10^9 years or so. The cosmological questions involved in the origin of the earth cannot be solved. Radioactivity, although helping to solve many geophysical problems, cannot in itself wholly explain the earth's thermal regime. R.S.Read

550.372

757. AN EVALUATION OF TWO RAPID METHODS OF ASSESSING THE THERMAL RESISTIVITY OF SOIL. L.W.Makowski and K.Mochlinski.
Proc. Instn Elect. Engrs, Paper No. 1942 M, publ. Dec., 1955. To be republished in Vol. 103 A (1956).

The methods are suitable for use in situ, with special application to the assessment of cable ratings. Brief consideration is given to the factors determining the thermal resistivity of the soil, i.e. its composition, compactness and moisture content, and then to the present standard method of measurement by buried spherical or cylindrical heater. The basis of the so-called transient-needle method is then set out. Theory, errors due to departure from ideal conditions and practical application are considered. A method based on soil sampling is next discussed. After critical considerations of the underlying theoretical and practical work by Gemant, Kersten and Mickley in the United States, a nomogram is introduced by means of which the thermal resistivity of sand-clay mixtures of known physical characteristics may be simply determined. The practical application of the two rapid methods, to field measurements is described, and results obtained by the various methods are compared. Finally, the new methods are discussed and compared with that using the static buried heater. A.

550.380.8

1758. APPARATUS FOR MEASURING THE INTENSITY OF THE TERRESTRIAL MAGNETIC FIELD. R.Birebent.
C.R. Acad. Sci. (Paris), Vol. 241, No. 4, 368-9 (July 25, 1955). In French.

The apparatus is based on an earlier design but adapted for measurement of the terrestrial magnetic field. A coil through which an alternating current passes is pivoted on one of its diameters and fastened to a piezoelectric crystal whose far end is fixed. The coil is mounted with its plane along that of the magnetic meridian and torsion occurs on the crystal for each alternation of the current. This torsion is amplified. The earth's field is compensated by the field generated in two Helmholtz coils with the same axes of rotation as the test coil and the current through them adjusted until no torsion remains. This current is measured and the magnetic field calculated. The apparatus can be rotated horizontally and vertically and thus the horizontal and vertical components of the earth's field obtained. It has a sensitivity of 0.01 oersteds and it can be increased by a larger apparatus. R.S.Read

550.384 : 551.510.535

1759. ELECTRICAL CONDUCTIVITY OF THE IONOSPHERE AND PERTURBATIONS OF THE TERRESTRIAL MAGNETIC FIELD OF MUSICAL AND LOWER FREQUENCIES. G.Grenet.
C.R. Acad. Sci. (Paris), Vol. 242, No. 3, 401-3 (Jan. 16, 1956). In French.

From known values of ionization of the upper atmosphere, the electrical conductivity along and perpendicular to the earth's magnetic field can be obtained, but polarization can

annul the action of the earth's field on conductivity. Adopting characteristic values for collision frequency of electrons, the number of electrons per cm^3 and thickness of the E-, F1- and F2-layers, values are obtained of the conductivity and critical frequency for transmission at midday and midnight for the three layers. These critical frequencies for the transverse conductivity of the F1- and F2-layers are of the same order of magnitude as rapid variations of the earth's field and they cannot be due to distant causes. Finally if the conductivity is that calculated in the direction of the earth's field the role of the ionosphere must be considerable even for slow variations of the earth's field. R.S.Read

550.93

1760. A NEW METHOD OF AGE ESTIMATION OF MINERALS CONTAINING RHENIUM BY NEUTRON ACTIVATION. W.Herr and E.Merz.
Z.Naturforsch., Vol. 10a, No. 8, 613-15 (Aug., 1955). In German.

Re^{187} decays naturally into Os^{187}. Only certain Os isotopes are made radioactive by neutron irradiation and these do not include Os^{187}; hence an estimation of Os by chemical and neutron activation will indicate the quantity formed from Re^{187} The quantity of Re^{187} present in the mineral can also be found by neutron activation and hence the age of the mineral. Only lg of mineral is needed and data for 5 samples from different regions are included. J.M.Hough

550.93 : 539.16.08

1761. C^{14} DATING WITH A METHANE PROPORTIONAL COUNTER. W.H.Burke, Jr and W.G.Meinschein.
Rev. sci. Instrum., Vol. 26, No. 12, 1137-40 (Dec., 1955).

Apparatus and procedures for conversion of sample carbon to carbon dioxide, quantitative hydrogenation of carbon dioxide to methane, and radiocarbon assay of the methane are described. Two sizes of counters are used. At the operating pressure of two atmospheres, the larger size contains 0.85 g of carbon and the smaller 0.22 g. If the sample and background are both counted for 24 hours in a 0.85 g counter, a sample 34000 years old (26000 years old in the 0.22 g counter) gives a C^{14} count equal to twice its standard statistical error. If desired, this method can readily be adapted to larger samples with a consequent increase in the maximum measurable age. A.

ATMOSPHERE. METEOROLOGY 551.5

551.510.41

1762. OZONE THEORY IN THE TROPOSPHERE. F.N.Frenkiel.
J. chem. Phys., Vol. 23, No. 12, 2440 (Dec., 1955).

It is suggested that the difference between theoretical and experimental values for the ozone concentration in the troposphere can be explained in terms of photochemical production in the troposphere due to the presence of small quantities of nitrogen dioxide and hydrocarbons. J.M.Hough

551.510.52 : 538.566

ON THE PROPAGATION OF ULTRA SHORT WAVES BEYOND THE HORIZON. See Abstr. 508.

551.510.535

1763. THE OCCURRENCE OF HIGH MULTIPLE REFLECTIONS FROM THE F2 REGION OF THE IONOSPHERE BASED ON A STUDY OF THE AHMEDABAD RECORDS. R.G.Rastogi.
Proc. Indian Acad. Sci. A, Vol. 41, No. 6, 253-60 (June, 1955).

Traces on P' f records which crossed the various traces diagonally have been shown to arise from high-order multiple reflections corresponding to a delay time in excess of the pulse repetition period. They occurred only at night and mo frequently in winter months. In general they are associated with a hump in the ionospheric surface over the observing station, indicating dynamic changes in the F2 layer even at night. G.M.Brow

551.510.53

1764. CONTRIBUTION TO THE STUDY OF THE EFFECT OF GEOMAGNETISM ON THE F1 LAYER. R.Eyfrig.
C.R. Acad. Sci. (Paris), Vol. 241, No. 12, 759-61 (Sept. 19, 1955). In French.

Results for various stations show that on the magnetic equator foF1 is a minimum (as reported by Ghosh, 1955), $h'F_1$ is a minimum, and the factors M3000-F1 and F1-3000-MUF have maximum values. G.M.Brow

551.510.53

1765. THE INFLUENCE ON THE RECORDINGS OF IONOSPHERIC SOUNDINGS OF THE E-LAYER OF THE PLANE O SEPARATION OF THE REGIONS OF QUASI-LONGITUDINAL (Q.L.) AND QUASI-TRANSVERSE (Q.T.) PROPAGATION. D.Lepechinsky.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 897-900 (Oct. 3, 1955). In French.

See Abstr. 5136(1955). It is shown that anomalous behav iour is found when the maximum electron concentration occu at or above the plane of separation of Q.L. and Q.T. propagat ion. J.M.Houg

551.510.53

RADIO-WAVE PROPAGATION IN THE IONOSPHERE
See also under "Electromagnetic waves and oscillations"
Decimal classification 538.566.3

551.510.535 : 621. 396.1

1766. DETERMINATION OF THE TRUE ELECTRON DENSITY DISTRIBUTION IN THE IONOSPHERE. I. W.Becker.
Arch. elekt. Übertragung, Vol. 9, No. 6, 277-84 (June, 195 In German.

A review of present methods.

551.510.535 : 621.396.1

1767. AERODYNAMICAL MECHANISMS PRODUCING ELECTRONIC DENSITY FLUCTUATIONS IN TURBULENT IONIZED LAYERS. R.M.Gallet.
Proc. Inst. Radio Engrs, Vol. 43, No. 10, 1240-52 (Oct., 1955).

Various radio effects of the turbulence in the low ionosphere are discussed with a view towards determining the order of magnitude of the turbulence parameters in this regi These effects include v.h.f. scattering, sporadic E-layer phenomena, and diffraction patterns in reflection. The required electron density fluctuations $(\Delta N/N)^2$ fluctuate aroun 10^{-4} and the scale of the turbulence l is roughly 100-200 metr approx. The latter quantity measured directly in the troposphere is of about the same order of magnitude. Pressure fluctuations result from the "collisions and extensions between turbulent eddies" in a uniform gas, or from vertical transport in the atmosphere with its varying pressure. It is shown that such pressure fluctuations are too small, by a factor of about 10^{-4}, to produce the observed density fluctuations. However, the vertical transport mechanism produces two other effects which are independent of the energy of the turbulence and are of the right order of intensity. First, in non-adiabatic atmosphere the vertical transport of air masse produces fluctuations of temperature. These, in turn, give rise to air density fluctuations, and proportional electron density fluctuations. Second, fluctuations of electron density result directly from transport in the presence of a gradient o electron density. These two effects, for the same uniform turbulence, occur at different levels in an ionospheric layer. They are sufficient to explain the stratification properties of sporadic E. An expression for the scale of turbulence is

btained from the gradients of winds circulating in the low nosphere. Hence, the properties of sporadic E phenomena ould be interpreted in terms of meteorological factors inds, synoptic masses of air, fronts, etc.). It is pointed it that the same transport mechanisms are acting in the oposphere, the gradients of water vapour content playing e role of the gradients of electron density. A.

551.521.3

68. APPLICATION OF THE CHANDRASEKHAR METHOD O THE STUDY OF RADIATION DIFFUSED IN LAYERS OF OG. J.Lenoble.
.R. Acad. Sci. (Paris), Vol. 241, No. 6, 567-9 (Aug. 8, 1955). French.

Chandrasekhar's method of approximations is applied to e diffusion of radiation from sun and sky in a plane homo- neous scattering layer of large particles (fog or sea). The tation and principles of the method are given and the equat- ns established. These are applied to two cases: (1) For y radiation only and no solar radiation; (2) for an infinite yer with solar radiation only. Curves show the results ob- ined, and these can be readily compared with experimental sults. R.S.Read

551.574.1

69. MEASUREMENTS OF NATURAL FREEZING NUCLEI T HIGH ALTITUDES. E.J.Smith, A.R.Kassander and Twomey.
ature (London), Vol. 177, 82-3 (Jan. 14, 1956).

Daily measurements were made from aircraft, Jan. 1954 d Jan. 1955, near Sydney, and Jan. 1955 near Tucson, of eezing nuclei. Similar observations were made in Jan. 1955 a mountain top in the Hawaiian Islands. Airborne samples ere obtained at different altitudes but only those above 00 m are quoted. Curves show the daily variation in the armest temperature at which one ice crystal per litre of air as observed. Bowen has attributed the rainfall singularities Australia to the arrival in the lower atmosphere of meteoric ist and consequent fluctuations in concentration of freezing clei. The curves show certain coincidences between rain- ll singularities and peaks in concentration of freezing nuclei different locations and at different times. R.S.Read

551.593.5

1770. HORIZONTAL ATMOSPHERIC TRANSMITTANCE MEASUREMENTS WITH A THALLOUS SULFIDE CELL TRANSMISSOMETER. C.A.Pearson and E.A.Boettner.
J. Opt. Soc. Amer., Vol. 46, No. 1, 54-9 (Jan., 1956).

Measurements of horizontal atmospheric transmittance were made over 1.24 and 4.07 sea-mile paths with an automatically recording near-infrared transmissometer. The transmissometer comprised a tungsten source, modulated at 60 c/s, and a thallous sulphide cell receiver. The visual transmittance was simultaneously recorded with a photomultiplier-tube receiver using the same source. New results of total transmissivity per sea mile in the 0.7- to 1.1-micron region of the spectrum are presented and compared with previous results in the visual and infrared regions of the spectrum. A graph of transmissivity versus wavelength from 0.3 to 12 microns was made. This graph is useful in finding the transmissivity in the "windows" of the infrared spectrum when the transmissivity has been determined at a particular wavelength or for a small band of wavelengths. A.

551.594.223

1771. ON THE NATURE OF BALL LIGHTNING.
P.L.Kapitsa.
Dokl. Akad. Nauk SSSR, Vol. 101, No. 2, 245-8 (1955). In Russian.

It is shown that previous hypotheses contradict the law of conservation of energy. A new theory is advanced, namely that the energy of ball lightning is derived from the absorption of incident radio waves, of wavelength 3.65 times the diameter of the ball. This is 35 to 70 cm for the most frequent ball diameters. The ball is located at one of the interference antinodes formed by reflection from the ground, or even at several such antinodes, producing beaded lightning. The hypothesis explains many observed facts, such as the explosive disappearance of ball lightning, its fixed dimensions and position, and its ability to enter rooms through windows or chimneys. It may also account for the phenomenon of St. Elmo's fire. The absence of any observations of the radio waves in question is ascribed to their rarity (since ball lightning is itself rare), and it is suggested that a search might be made for them during thunderstorms. It might also be possible to produce ball lightning in the laboratory if a suitable source of radio waves could be obtained. J.B.Sykes

BIOLOGY 57/59

578.087.9

72. CONTINUOUS RECORDING OF THE GROWTH OF ICRO-ORGANISMS UNDER TURBIDOSTATIC AND CHEMO- TATIC CONTROL. P.A.Anderson.
ev. sci. Instrum., Vol. 27, No. 1, 48-51 (Jan., 1956).

The microbial auxanometer, an instrument which automatically records the growth rate of a micro-organism during its ntinuous growth under turbidostatic control, has been developed further to provide (1) interchangeable turbidostatic and emostatic control, (2) automatic recording of culture density der chemostatic control or during uncontrolled growth, and) improvements in growth tube design which reduce cell trapng. The instrument delivers a continuous record of the owth history of the organism under either free-growing or owth-factor-limited conditions and of changes in growth rate duced by physical or chemical means. It is well adapted to e study of spontaneous and induced mutation rates. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.171.1

1773. JERKMETER FOR BALLISTOCARDIOGRAPHY.
T.A.Perls and C.W.Kissinger.
Rev. sci. Instrum., Vol. 27, No. 1, 51-5 (Jan., 1956).

"Jerk" is defined as the time derivative of acceleration. Simple methods for designing jerkmeters are briefly discussed. The present design consists of a low-frequency (20 c/s) piezoelectric accelerometer, the output of which is electrically differentiated. The response of the instrument is flat within ± 7% from zero-frequency to 18 c/s, at 21° C, but changes in response up to 33% are introduced in the range between 10 and 18 c/s at temperatures between 12° C and 32° C. A ballistocardiogram is shown, with simultaneous displacement, velocity, acceleration and jerk records. A.

612.76 : 531

1774. TWO NOTES ON THE PHYSICS OF WALKING. R.M.Sutton.

Amer. J. Phys., Vol. 23, No. 8, 490-1 (Nov., 1955).

(1) Walking is related closely to a succession of motions approximating half-cycles of a simple harmonic motion. The large velocities and accelerations involved are computed. (2) The support of the body on the ball of one foot, as in walking, introduces large forces in bones and muscles which are analysed. (3) A simple experiment related to standing on tiptoe is described. A.

612.843.611

1775. FOVEAL LIGHT ADAPTATION AS AFFECTED BY THE SPECTRAL COMPOSITION OF THE TEST AND ADAPTING STIMULI. W.R.Bush.

J. Opt. Soc. Amer., Vol. 45, No. 12, 1047-57 (Dec., 1955).

Foveal light adaptation was investigated as a function of wavelength by the luminance discrimination method using three nearly monochromatic lights (red, green and blue) employed in all possible adapting stimulus-test flash combinations. Subjects viewed two fields of light. The larger subtended 4^{0} 44' (the adapting stimulus), and the smaller subtended 47' (the test flash) and was superimposed upon the adapting stimulus. The data indicate that: (1) The largest selective effect of wavelength occurred from 0.00 to +0.05 sec, where the following results were obtained: (a) The greatest adaptive effects uniformly occurred for monochromatic combinations. (b) A lesser effect occurred for heterochromatic combinations. (2) These selective effects were in the same direction but greatly reduced after fifteen minutes of adaptation. (3) Both as a test flash and as an adapting stimulus, the blue acted as if it were transmitting more luminous flux than it actually was. (4) Light adaptation under these experimental conditions was virtually complete after thirty seconds of adaptation. The results seem to indicate that the degree of interaction between groups of neural elements which react selectively to various wavelengths is reflected in the psychophysical changes in thresholds reported in this study. In addition, the striking differences in the contributions of the blue mechanism to luminance and to chromaticness have also been reflected in the psychophysical dat A

612.858.76 : 534.3

1776. AUDITORY-THRESHOLD RECOVERY AFTER EXPOSURES TO PURE TONES. I.J.Hirsh and R.C.Bilger.

J. Acoust. Soc. Amer., Vol. 27, No. 6, 1186-94 (Nov., 1955

A modified Békésy-type audiometer was used to obtain a continuous recording of the auditory threshold before and after monaural exposures to different durations and intensiti of pure tones. Preliminary studies confirmed the observations of Reger that the amount of temporary hearing loss at 1 kc/s following a 1 mín exposure to a 1 kc/s tone is greater when the stimulating tone is 20 db above threshold than when it is 80 db above threshold. Temporary hearing loss at higher frequencies, however, increases with exposure level. These preliminary results led to an investigation of the dependence of temporary hearing loss on the duration and the intensity of exposure tones. Recovery curves for the thresh old at 1 kc/s following exposure by 1 kc/s indicate that exposure tones at or above 60 db sensation level yield a rapid recovery followed by either a slowing down of the recovery process or a second rise in the threshold. Following exposure to a 20 db tone, however, this rapid recovery is not so apparent, and therefore, when the temporary threshold shift is measured soon after exposure, the apparent loss after 20 db is greater than after higher intensities. The hearing loss two minutes after exposure does not change with increas ing exposure level until the sensation level exceeds 80 db. Also, temporary hearing loss does not change significantly with exposure durations from 15 sec to 1 min but increases as the durations increase to 2 and 4 min. These findings do not hold when the threshold for 1400 c/s is measured following exposure to 1 kc/s. Here, temporary hearing los increases directly with duration for sensation levels at 80 d or above, and it increases directly with level for sensation levels greater than 60 db. Although these results are somewhat obscured by differences among individuals, the recover curves, and their dependence on intensity and duration of exposure, point to more than one underlying recovery process. A

TECHNIQUE. MATERIALS 62/69

PHOTOGRAPHY 77

771.35

1777. THE MANUFACTURE OF A LARGE TARGET USED FOR THE STUDY OF PHOTOGRAPHIC OBJECTIVES. J.G. du Marache.

J. Phys. Radium, Vol. 16, No. 8-9, 735-6 (Aug.-Sept., 1955). In French.

For determining the transmission coefficients of a photographic lens, it is necessary to make a large line target to image on the film. A method of making a large target from clock-spring strip is described and practical details given. R.W.Fish